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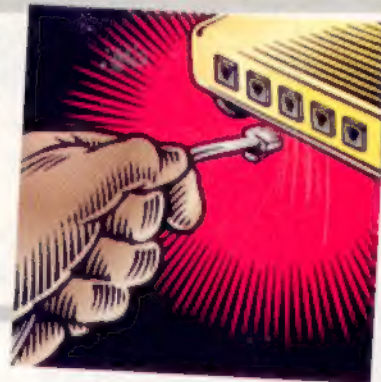


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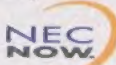
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From the Editor-in-Chief

I. Want. To. Talk. To. You.



Wouldn't it be nice to talk normally to our computers, just as we've seen the characters in "Star Trek" do? Of course, the computers in "Star Trek" understand what you're saying, and that's still a long way off. But I've been talking to my computer a lot more, recently, thanks to new software that makes it recognize normal speech patterns.

The breakthrough product here is Dragon Systems' NaturallySpeaking, the first continuous-speech voice-recognition program designed for general dictation (reviewed in First Looks, page 64). Until now, most voice-recognition programs supported discrete speech. Examples include Dragon Dictate, Kurzweil Voice, and IBM's Simply Speaking and VoiceType. These work well in special circumstances. But. You. Have. To. Speak. Like. This.

We have seen so-called continuous-speech products that allow for normal dictation, but typically these have been offered for applications that require a specific vocabulary, such as legal or medical terms. What makes NaturallySpeaking and IBM's soon-to-be-released Via Voice different is that they offer large-vocabulary, continuous-speech recognition. Their promise is that you can speak normally and the program will understand what you say. These programs are designed to replace dictation machines and give you hands-free typing.

Having used other voice recognition programs on and off (mostly off) for the past 13 years, I was skeptical. But I found the products better than I expected. They are not perfect, but they work well enough to create a rough draft of a letter or a report once you get used to speaking, not typing. As I work with these products, I'm finding they are about 90 percent accurate; Dragon's program is a little better.

In NaturallySpeaking, the app writes the words you speak, and you can save what you've spoken as an .RTF file or copy the material to the Clipboard and an application. You can even edit your text within that application by speaking specific phrases. Saying phrases like "select word" or "spell that" is cumbersome and more

time-consuming than editing by hand, but it does allow hands-free use of the program. You can still edit the old-fashioned way if you want (and much of the time you will).

Via Voice, due on the market shortly, has the same basic concept but implements it differently. With Via Voice, you can use either the app or Microsoft Word for recognition. That saves a step and

makes for a more seamless user experience.

It's easy to see how these products can and will improve dramatically over the next few years as PCs get more processing power and vendors have more experience with users. Accuracy should improve. Right now, speech recognition reminds me of OCR technology ten years ago—good but not great. Today, OCR software is dramatically improved.

At the same time, it's easy to see where vendors will be able to add the best features of the discrete-speech recognizers to these newer programs. Ideally, I'd like one program that includes command-and-control features for your operating system and applications—and accepts continuous dictation. And it should work from within any application. Ideally, it could be combined with a speech-synthesis program that would verbally prompt you for information.

All of these things seem possible within the next few years. But the real breakthroughs are farther off, when the programs can better differentiate the context of what you are saying. Even then, that doesn't mean the computer will understand what you mean. That's just science fiction. But having it recognize words as you speak them is a big step forward.

As for today, we're still not completely there. I was using one of the programs when two coworkers walked in my office. "Hello, Nick and Ben," I said.

"Hello Naked Men," the program typed.

Not quite the same thing.

A stylized, handwritten signature of Michael J. Miller in black ink.

MICHAEL J. MILLER

UMMA IS A BELLA ARE YOU TREBLE REBEL REBEL ON THE DOUBLE TO SOME TROUBLE.

The headline makes absolutely no sense. Neither does buying NT PCs for mission critical, complex applications. Especially when the new Sun Ultra™ 30 workstation performs compute-intensive chip simulation and 3D graphics with a speed and accuracy never before seen. Ultra 30's breakaway technology allows your departments to simultaneously network, collaborate, access data, design, and print faster than ever before. (Check specs below and then come back here, please.) For more information, visit us at www.sun.com/q-pcmag



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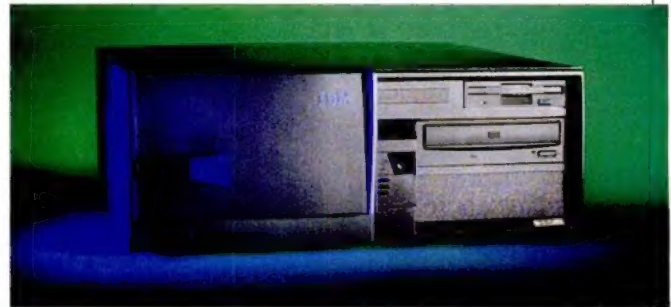
COVER STORY

The Two Faces of 300 MHz



BY CAROL VENEZIA

We always want more and more power in our PCs, and this is especially true for graphics fans. You know the ones—the more graphics they get, the more they want. Fortunately for both the applications user who loves graphics and the real live power graphics user out there, more is here today, in the form of high-end PCs and graphical workstations based on Intel architecture. PC Magazine Labs tests eight systems, most built around the Intel 440FX or the new Intel 440LX chip set, both of which are aimed at bringing the PC platform fully into what Intel calls “the era of the visual connected PC.” And they’re more affordable than you might be thinking.....100



High-End PCs	
AST Computer.....	102
Dell Computer Corp.	108
Gateway 2000 Inc.	108
Micron Electronics Inc.	113
NEC Computer Systems Division	116
Workstations	
Dell Computer Corp.	116
IBM PC Co.	117
Micron Electronics Inc.	119
Introducing AGP.....	
Editors' Choice.....	103
Performance Tests.....	104
Summary of Features.....	113

FEATURES



PCs

The Best CPU for Your Next PC

BY MICHAEL SLATER

Counting CPUs from Intel, AMD, and Cyrix—at all clock speeds—you currently have more than two dozen to choose from. Which will it be? In part, that depends on which applications you'll be running most frequently. Pricing strategies make the decision more interesting. We put 12 of today's leading x86 processors through our benchmark and applications tests 122

Processor Time Line	122
Microprocessor Pricing	125
Microprocessor Features.....	130
Mobile Processors Lag Desktops	132
The Alpha Alternative.....	136
Cyrix MediaGX Offers Entry-Level Option.....	145
Performance Tests.....	148
New Low-Cost MMX Alternative from IDT.....	165

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Bang for the Buck

If this issue's story on alternative CPUs makes you wonder whether you can find a computing bargain by turning to a processor from a source other than Intel, PC Magazine Online has some answers. Consult our exclusive interactive price/performance viewer and see for yourself if new chips from AMD and Cyrix have what it takes.

UP FRONT

From the Editor-in-Chief.....	4
Pipeline.....	9
Letters.....	21
Trends.....	28
▶ The lure of the low end	
▶ Caring for your nest egg online	
▶ Inside PC Labs	
▶ Intel promises low-cost, easy-to-use digital cameras	

First Looks.....	45
▶ Affordable Desktop Power: Five Cyrix 6x86MX PCs	
▶ Compaq Professional Workstation 6000	
▶ Corel WordPerfect Suite 8	
▶ Dragon NaturallySpeaking	
▶ Adobe After Effects 3.1	



Second Looks.....	81
▶ Net2Phone: Long-Distance Answer	
▶ Nuts & Bolts: Adding to the Essentials	

COLUMNISTS

JAKE KIRCHNER.....	31
BILL MACHRONE	85
JOHN C. DVORAK.....	87
INSIDE TRACK	89
JIM SEYMOUR.....	93
BILL HOWARD.....	95

FEATURES

NETWORKING

Network in a Box



BY STEVE RIGNEY

Small networks are popping up everywhere. Networking companies have responded by offering kits that provide everything you need—network adapters, cabling, hubs, and much more. Isn't it time you networked your home office?167

Dayna Network Starter Kits	174
D-Link Network Kit	180
Hewlett-Packard Network Kit	185
Linksys Instant Ethernet Series Network Starter Kit	186
NDC Software Network Personal Starter Kit	191
NetGear Network Starter Kit	191
3Com OfficeConnect Networking Kit	195
Five Steps to a Small-Office Network	168
Editors' Choice	169
Network Operating Systems for the Small Office	170
Thumbs Up, Thumbs Down: Small-Office Network Kits	172
Small-Office Networking Glossary	174
Summary of Features	176
Hub + Router Does It All	184
User Testing: Getting That Net to Work	192
And Then There Are the Cables	193

UPSs

The Power Brokers

BY WINN L. ROSCH

Brownouts, blackouts, surges, and spikes: Protect your servers from all of them with one of these network-class UPSs. We assess how they handle "power events" and other things such as line conditioning197



APC Smart-UPS 2200	204
Best Power Fortress LI1420U	205
Best Power Fortress LI2KH	205
Deltec PowerRite Pro II	209
Exide NetUPS SE	209
Liebert PowerSure Interactive	212
MGE Pulsar EX20	214
Para Systems Minuteman XRT 2000	216
Toshiba 1400SE	217
Tripp Lite Smart 2200 Net	217
Determining Your UPS Needs	198
Language of Power	199
Editors' Choice	200
Performance Tests	208
Personal Powerhouses: Protecting Individual PCs	212
Summary of Features	216

PC TECH

The 1997 PC Magazine Shareware Awards



BY SHERYL CANTER

For our fourth annual shareware competition, we evaluated some **54 newly released or significantly upgraded programs in 11 categories**. To arrive at these finalists, we evaluated productivity applications, graphics and multimedia tools, system utilities, HTML editors, and many others. For the first time, we also name a Program of the Year: one that really stands out from the crowd219

PC TECH

Tutor	229
Y2K: Facing the millennium challenge.	
Operating Systems	235
Server clustering reduces server unavailability.	
Power Programming	241
Distributed programming with CORBA and IIOP.	
Internet Tools	245
Pushing the envelope with push technology.	

PC SOLUTIONS

User-to-User	251
Personalizing your system.	
Ask Our Advisors	259
▶ Hardware: Interpreting start-up beef codes.	
▶ Operating Environments: DriveSpace compression	
▶ Word Processing: File date and time in WordPerfect 7.	
▶ Spreadsheets: Chart Y-series from multiple worksheets.	
▶ Databases: Pages of labels.	

AFTER WORDS

After Hours	321
Abort, Retry, Fail?	344
ALSO IN THIS ISSUE	
PC Magazine Marketplace	287
Premier	289
Classified	305
BusinessCard	318
Reader Service Card	335
Advertisers' Index: Companies	339
Advertisers' Index: Products	340
Coming Up	342
Editorial Product Index	343

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How to Improve Your OCR Accuracy and Save Your OCR

Caere Corporation (NASDAQ: CAER) recently announced an upgrade that makes the OmniPage Pro optical character recognition (OCR) major software available for an estimated street price of only \$129. This provides an inexpensive way for scanner users to step up to fully-featured OCR products (including those handled with flatbed and sheet-fed products) via upgrade to the full version of OmniPage Pro at a \$30

OmniPage Pro has a separate upgrade package available through Computer City, Egghead, and Best Buy. Since the vast majority of Caere OCR, most scanner users are eligible to upgrade at this price.

The large number of scanner manufacturers that bundle Caere OCR (Microtek, Canon, Plustek, Umax, Nikon, Agfa, Logitech, Reliemy, etc.) are eligible for the upgrade.

The upgrade program includes OmniPage Pro 6.0 (Windows 3.1 and Windows 95), which offer all the capabilities of the bundled software for extended functionality. Most notable among them are high-resolution "zoning" and preprocessing of scanned images, verifiers for the Page technology for the retention of the original page formatting, and as OCR training and deferred processing capabilities.

The Changing OCR Market: In the not so distant past, OCR required hardware and OCR software that was often difficult to use and provided little vertical markets. The use of desktop OCR was limited to the "early

"Today, several trends are contributing to the widespread use of OCR users faced," said Chad Kinzelberg, Caere's vice president of market. OCR users faced, is another major factor that will promote the use of occasional OCR user will find Caere software more attractive because

Analysts following the OCR market agree that OCR use is on the rise and industry trends promoting its mainstream adoption.

Higher Customer Awareness: An increased number of computer users are realizing the time and money saving benefits it provides.

Higher Scanner Penetration: Scanners prices have dropped drastically many flatbed grayscale scanners available for under \$500. Also, the (such as the small-footprint sheet-fed scanners) and multifunction

Increased OCR Accuracy: OCR developers have developed high accuracy OCR technology for increased output. The greatest improvement has been made on degraded and hard to read documents.

How to Improve Your OCR Accuracy and Save Big \$\$\$

Higher Scanner Penetration:

Scanners prices have dropped drastically in the last few years with many flatbed grayscale scanners available for under \$500. Also, attractive, new scanner form factors (such as the small-footprint sheet-fed scanners) and multifunction devices have entered the market.



Low cost scanners entering the market have helped push OCR use to a new level.

Increased OCR Accuracy:

OCR developers have developed high accuracy OCR technology for increased output. The greatest improvement has been made on degraded and hard to read documents.

Pricing and Availability

OmniPage Pro 7.0 (Windows and Mac) and WordScan Plus 4.0 (Windows) upgrade packages are immediately available at major resellers for an estimated street price of \$129.

The Company:

Caere Corporation, with U.S. headquarters in Los Gatos, Calif. and European headquarters, Caere GmbH, in Munich, Germany, is a leader in OCR technology and desktop document management products. Caere has recently expanded its product line of OCR

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even outputs to
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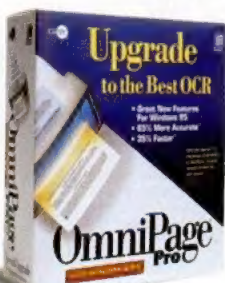
Sure, the OmniPage Limited Edition OCR that came with your scanner is good. In fact, that's why scanner makers like HP, Microtek and Agfa chose it above all others.

But if you want greater accuracy, full-throttle speed and a ton of new time-saving features, then it's time you moved up to OmniPage Pro®.

OmniPage Pro employs a new, more powerful OCR engine to recognize poor copies and degraded faxes. It integrates seamlessly with your favorite applica-

tions like Word, WordPerfect and more. It even guides you through the OCR process using its AutoOCR Toolbar. All with the simple push of a button.

What's more, you get the advantages of the world's most popular OCR software without learning an entirely new program. So make sure you're getting all the OCR power and accuracy you deserve. Visit a local computer retailer today to get your \$30 mail-in rebate coupon.



Now Just \$99
with mail-in rebate.



Key Feature Comparison	OmniPage Pro	OmniPage Limited Edition
Caere's fastest and most accurate OCR engine	✓	
AutoOCR Toolbar™ for easy, one-button OCR processing	✓	
OCR Wizard to guide you through the process	✓	
Integrates with most image editors like Photoshop	✓	
OCR from within your favorite applications	✓	✓
Retains original layout	✓	

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Pipeline

Processor Prices Plunge

Expect to see traffic jams in the parking lot at CompUSA. Recent reports of PC sales growing at a healthy clip and computer stocks soaring offer heartwarming news for stockholders, but that's only half the story. Intel's midsummer price cuts and its expected November cuts mean that PC shoppers can expect big bargains in the second half of the year.

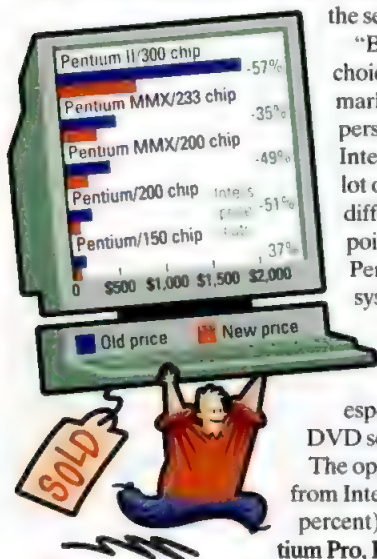
"Buyers can look forward to lots of choices in the low-end, sub-\$1,200 market," says Kevin Hause, a personal-systems research analyst at International Data Corp. "There's a lot of opportunity for vendors to differentiate themselves there," he points out. Hause expects to see Pentium II PCs and maybe even systems with DVD drives dropping below \$2,000. But he cautions, "It remains to be seen how popular DVD systems will be, especially considering the dearth of DVD software."

The optimistic predictions result partly from Intel's big July price cuts (by up to 57 percent) on most of its Pentium II, Pentium Pro, Pentium MMX, and mobile

Pentium processors—cuts that bring the Pentium Processor with MMX Technology to entry-level desktops. According to Intel, the new prices reflect greater-than-expected manufacturing savings.

Compaq started the summer round of PC price cuts by introducing sub-\$1,000 Pentium/166 PCs and lowering prices across the board by 2 percent to 22 percent. Dell cut its prices by up to 16 percent, and Hewlett-Packard also announced reductions.

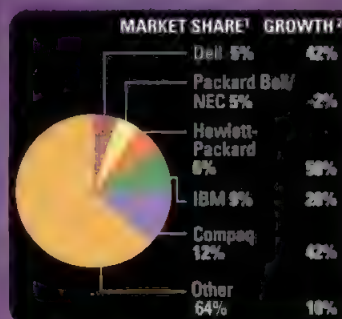
How can PC companies sustain such deep price decreases? For one thing, they're weeding out inefficiencies in manufacturing and distribution. Changes in the supply chain will also help lower costs, a trend that has already begun with improved processes for procuring components.



Worldwide PC Rankings

Sales soared for PC vendors in the second quarter of this year, with worldwide shipments 17 percent higher and U.S. shipments about 22 percent higher than a year earlier, according to Dataquest. (International Data Corp. reports 15 percent worldwide growth and 19 percent U.S. growth.)

(1) 2Q 1997 (2) 2Q 1996 to 2Q 1997



Source: Dataquest

Forget Your Password

Someone can steal your password, and someone can steal your PIN, but nobody's going to steal your fingerprint. That's why more and more developers are designing fingerprint identifica-

personal computer gadget to use a TI image sensor is American Biometric Company's BioMouse, a desktop fingerprint scanner that polices access to your PC.

The BioMouse (below) is just one of several new PC security systems that do away with passwords in favor of biometrics, which relies on fingerprints, face



tion gadgets as PC peripherals.

You probably know Texas Instruments for its notebooks, but you may not know that it's a major manufacturer of semiconductor components. For example, it produces digital image sensors—whose uses include fingerprint scanning—as well as memory chips and digital signal processors. (In fact, TI sold its notebook division to Acer in January to focus on its core business.)

Texas Instruments' digital image sensors—known as charge-coupled devices, or CCDs—are used in all kinds of imaging products, from scanners to traffic lights that photograph cars speeding through red signals. The latest

prints, and voice prints. The TI sensor in the \$299 BioMouse captures an image of your fingerprint and compares it with a recorded "reference feature file" based on the authorized fingerprint. American Biometric (www.abio.com) is working with developers to make their apps BioMouse-aware.

Meanwhile Sony, one of TI's major competitors in image sensors, has introduced its \$600 Fingerprint Identification Unit (FIU). And I/O Software (www.iosoftware.com) has created a developers' kit for applications that authorize log-ons and smart-card transactions, encrypt data, and control access to files, rooms, and buildings.

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Alternative CPUs Have Arrived

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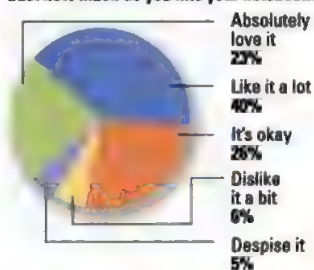
Pipeline

Satisfied with Your Notebook?

Here's some good news: About 80 percent of the 800 PC Magazine Online readers who participated in a recent online survey are satisfied with their notebook purchases.

Not surprisingly, a large percentage (37 percent) said that

Just how much do you like your notebook?

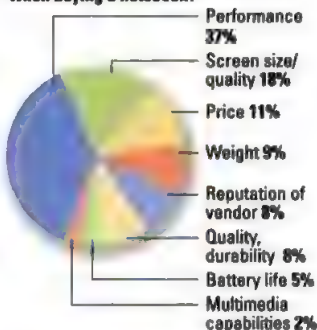


Source: PC Magazine Online survey, summer 1997

performance was the most important criterion in their purchase decision. Other factors—including screen size and the notebook's quality, price, and weight—did figure into decisions, but far fewer respondents referred to any of those criteria as the single most important one.

In addition, 23 percent of respondents absolutely love their purchases, but a vocal 11 percent are kicking themselves. The most common complaints: short battery life and excessive weight. Some respondents were seduced by low prices at the expense of other features. Those who love their notebooks went

What's your most important consideration when buying a notebook?



Source: PC Magazine Online survey, summer 1997

for high-end desktop replacements and praised such features as speed, full-motion MPEG, and a big screen.

Silicon Guitar

Ever wonder how engineers are able to squeeze more and more transistors onto a sliver of silicon? Consider this march of technology: Intel's 386 has 275,000 transistors; the 486 has 1.2 million; the original Pentium has 3.3 million; and the Pentium II has 7.5 million. Chip sizes shrink with each generation, too.

Behind such mind-boggling achievements are advances in lithography, the process that creates the tiny components on an integrated circuit.

At the Cornell Nanofabrication Facility, doctoral student Dustin Carr and physics professor Harold Craighead recently built a "nanoguitar" using advanced electron-beam (E-beam)

lithography. Just 10 microns long, it's one of the world's smallest silicon devices. (A micron is one-millionth of a meter; a nanometer is one-billionth of a meter.) An atomic force microscope plucks the strings, producing a sound that is inaudible to the human ear.

The project is a milestone in the quest for smaller chips studied with even more transistors.

Today's photolithography process can't produce "features" much smaller than 1 micron.

Building devices of nanometer dimensions requires a more precise technique such as E-beam lithography, which scans a beam of electrons across silicon covered with sensitive film. The electrons produce a chemical change that creates a pattern—in this case, a guitar.



THIS ISSUE'S CONTRIBUTORS: *Angela Hickman, Carol Levin, Cade Metz, and Don Willmott.*



Home Worker

"In the future, we believe speech technology will serve as the basis for all man/machine interfaces," suggested Gaston Bastiaens—CEO of Lernout & Hauspie, a speech recognition developer—at the company's recent technology showcase in Boston. In addition to selling its own products, such as the continuous-speech product Kurzweil VoiceCommand, L&H licenses its software to over 150 companies in the speech technology industry.

One such company is Home Automated Living (HAL), the developer of HAL2000: software that controls home systems such as heat, lighting, and security and delivers e-mail and Web content via telephoned commands. From any phone you dial your number, punch in your password on the phone keypad, and speak to HAL, which recognizes your voice and executes your command.

Planned for an August launch, HAL2000 will cost \$399.

Diapers at Your Doorstep

Whether you're in the market for a new computer, a used car, software, or even today's hippest CD or best-selling book, you can find it somewhere in cyberspace. Now, some entrepreneurs are hoping to turn Web-based grocery stores into the newest retailing success on the Web.

NetGrocer—the first nationwide online grocery—offers nonperishables from cereal to diapers either at or below retail prices, says company chief Daniel Nissan. This discount, he says, saves



shoppers anywhere from \$100 to several hundred dollars annually. NetGrocer makes all of its deliveries via Federal Express (\$2.99 for the first 10 pounds and 99 cents for each additional 10 pounds), and they are guaranteed to arrive in two to four business days.

Top-Selling Retail Games

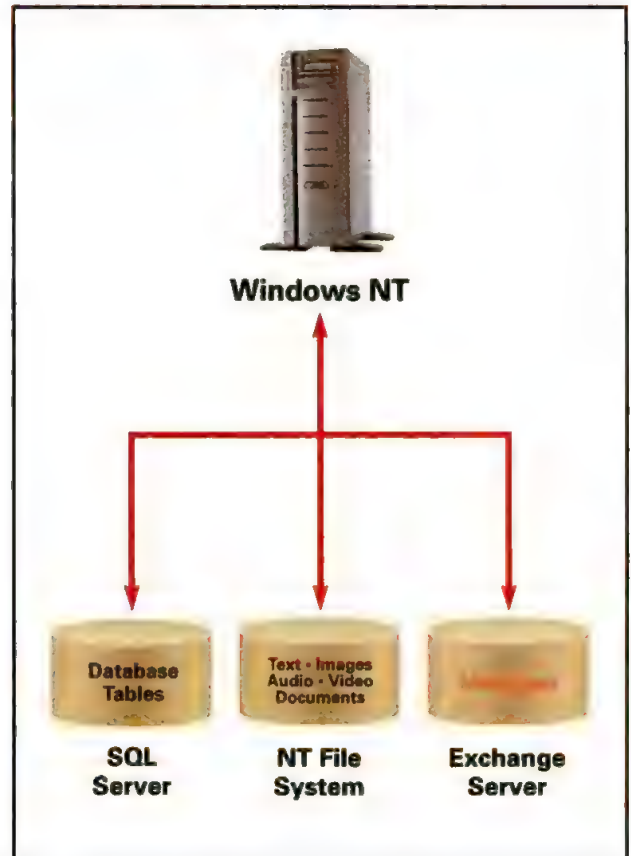
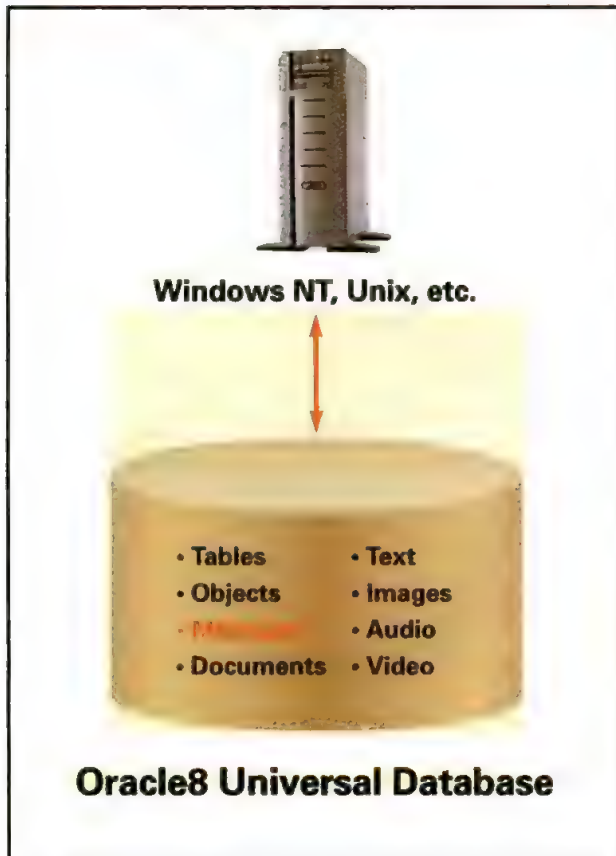
- 1 **Myst** Broderbund Software
- 2 **Dialo** CUC Software
- 3 **X-Wing vs. TieFighter** LucasArts Entertainment
- 4 **Command & Conquer Red Alert** Virgin Interactive Entertainment
- 5 **Monopoly Multimedia** Hasbro Interactive
- 6 **NASCAR II** CUC Software
- 7 **Command & Conquer Counterstrike** Virgin
- 8 **Need for Speed II** Electronic Arts
- 9 **CPolice Quest V: SWAT** CUC Software
- 10 **Microsoft Return of Arcade** Microsoft

Source: PC Data. Data for June 1997.

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Microsoft Exchange Email



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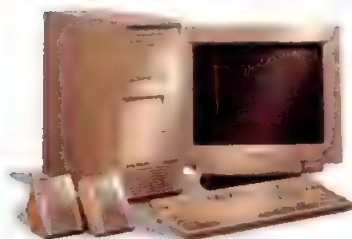
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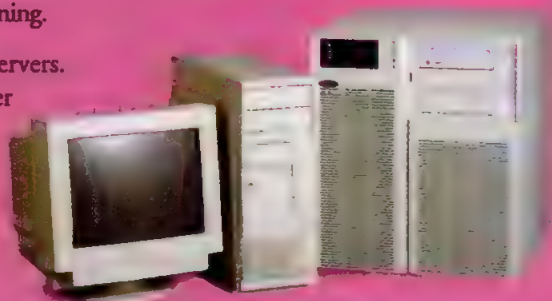
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Letters

DIFFERENT OUTLOOKS

Strange that Jim Seymour thinks Outlook97 is the greatest thing since sliced bread ("PIMming Around in the Outlook Era," July 1997), yet John C. Dvorak (Inside Track, June 10, 1997) thought it so bad as to call it a "slow pig" and to state publicly that it should be rewritten from the ground up.

HENRY S. WINOKUR
Bethesda, Maryland

Talk about confusing advice from a publication that we rely on for solid information. It seems that Dvorak and Seymour must be evaluating different software, given their recent conflicting comments on Outlook.

DAVID LEMIRE
Columbia, Maryland

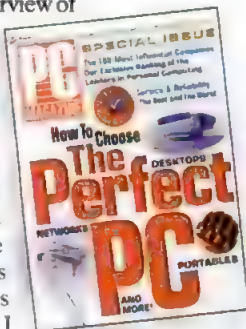
Dvorak's reply: Jim and I are not on here to agree on everything. In fact, the columnists are not here to agree with anyone. We're here to provide perspective to help readers make decisions. As far as Outlook is concerned, I'm not the only one who finds it lacking, and Microsoft is planning a substantial redesign. Even Bill Gates and Steve Ballmer admitted in a recent interview that its release may have been premature.

Seymour's reply: Well, John and I obviously disagree. Millions of PC owners are happily using Outlook today, and soon enough, millions more will soon be using "Outlook Jr.," also known as Outlook Express, the very nice mail client (sans the full version's PIM capabilities) included with Microsoft Internet Explorer 4.0. Outlook, even in its first version, is eminently usable and provides the basis for very good integration among scheduling, contacts, and e-mail. Watch for it to get even better with succeeding releases. And hey, John, remember: Outlook comes free in the box with Office97.

IMPERFECTIONS

I found this year's Perfect PC issue (July 1997) disappointing. For the past few years, I've looked forward to the issue because it had in-depth articles about the various PC subsystems. This year, all I found were short blurbs that gave a quick overview of

each part but no real comparisons. For example, you basically state that an EIDE hard disk is acceptable for most people, but that SCSI offers more performance for more money. This seems obvious. As in previous years, I



"Dvorak and Seymour must be evaluating different software."

would have found it more useful if you had made real comparisons to show how much better or worse systems performed.

ANDREW VISSCHER
via the Internet

I found your recent issue on choosing the Perfect PC to be excellent. The information is most helpful and complete. Nevertheless, the cover story does have one minor oversight. At no time did the columnists or writers discuss whether hardware manufacturers have developed USB add-on cards to older motherboards that don't have USB already.

XAVIER BASORA
via the Internet

GRADINGS AND RATINGS

I've recently completed an analysis for a recommendation to purchase next-generation notebooks, so I was interested in your Service and Reliability Survey ("Readers Rate PC Service & Reliability," July 1997). Based on features, it came down to Micron and Toshiba, with Micron, for our purposes, having a slight edge. I'd recognized Toshiba's reliability, though, so I was interested to note its drop to a B rating. I noted the praise given Micron in the article, so I read the review closely, trying to determine why this company is also given a B rating. Looking at the chart, I do not understand the explanation given for the B rating: "The vendor gets

above-average scores on all measures except recent repairs." The chart shows that Micron has the lowest percentage of units needing repair over the past 12 months (23 percent), beating Dell (25 percent) as well as all of the others, yet Dell receives the only A.

MIKE TIMSON
via the Internet

When I first read your ratings of PC vendors, I thought the way the lines were drawn between *below average*, *average*, and *above average* was too subjective. Then I read the sidebar "How We Surveyed" and was very impressed with your staff's statistical expertise. Not only was your explanation simple enough for anyone to gain some understanding, but it showed that you take this survey seriously with respect to presenting the truth, and that you did not just flash up averages.

MARK FRANJONE
via the Internet

I like your annual Perfect PC issue and your article on how readers rate desktop and notebook service and reliability. I wish you would add file and application servers to your evaluation, as well as companies that make servers. A section on how readers rate servers, as well as the reliability and service the vendors provide, would help IS professionals pick the best possible server.

EARL MOORE
Starkville, Mississippi

DIRECT MESS

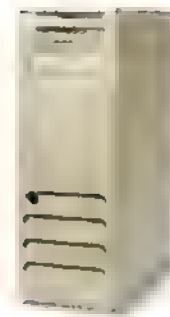
I read with great sympathy about the misadventures Bill Machrone and son had with DirectX ("DirectX: The Party Pooper," July 1997). My experience, though not as bad as his, was pretty bad: crashes and freezes, conflicts, and multiple uninstall/reinstall cycles. The problems were compounded by the fact that I use a Hebrew version of Windows 95, which is much less stable than the English version. DirectX sounded so good on paper, and I was looking forward to Windows games that were easy to install and performed like the good DOS games. I'm disappointed, but happy to see that someone is talking about this problem in public. Maybe now Microsoft and the hardware vendors, especially Creative Labs, will work on getting their act together.

MENASHE AARON
via the Internet

I find it very hard to believe that Machrone had problems with DirectX. I am an avid PC gamer who owns several games that utilize DirectX. Neither I nor anyone else I know has had difficulty with DirectX. I think Microsoft created a good API for games, which has

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Letters

helped increase the graphics and sound capabilities of next-generation games.

MATT BATTAGLIA
via the Internet

A round of applause for Machrone in writing something about the nonsensical situation concerning Microsoft's gaming API. DirectX and D3D invariably provide painful experiences for users setting up and installing games on their PCs. For a company that is obsessed with creating, imposing, and owning the single standard in all aspects of personal computing, Microsoft would do better than just trying to outmuscle the competition by actually thinking about what the consumer—rather than itself—wants.

SUHAIL AKHTAR
via the Internet

COMMON KNOWLEDGE?

Bill Howard's column "The Technicolor Revolution" (June 24, 1997) gave a fine overview of color printers. My only complaint concerns the sentence "The total life-cycle cost of a \$500 printer with bigger tanks may be less than that of a \$300 printer with ink tanks the size of crack vials." The assumption that your readers are familiar with crack vials is a sad comment on your view of society. To offer at least one data point, I must say I do not know how big a standard crack vial is and have no desire to find out.

ANDY MCMILLAN
via the Internet

PUT THE GUNS AWAY

As a loyal *PC Magazine* reader (over ten years), I am puzzled by one section of your July 1997 issue. In your First Looks article "A

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CORRECTIONS AND AMPLIFICATIONS

In our August 1997 cover story, "Portable Power," we incorrectly stated that the Hewlett-Packard OmniBook 800CT has a 166-MHz Pentium CPU and that a CD-ROM drive is not available. The 800CT has a 166-MHz Pentium MMX CPU, and there is an optional 8X CD-ROM drive.

In the August 1997 Trends/PCs sidebar "Maximum Capacity" (page 33), we meant to say that the SuperDisk LS-120 was capable of storing almost 85 times more data than a 1.44MB floppy disk drive, not 85 percent.

In the July 1997 First Looks article "A New Era of Video Editing," our review of the MGI VideoWave (page 49) has a misprint. The sentence "The program can't display SMPTE time code (which uses milliseconds instead of frame numbers to indicate units smaller than 1 second)" should read "The program can't display SMPTE time code; it uses milliseconds instead of frame numbers to indicate units smaller than 1 second." SMPTE uses frame numbers; MGI uses milliseconds.

In our July 1997 Internet Tools column, "Dynamic HTML: More Client, Less Server," we should have identified the graphic on page 246 as part of a demonstration of HTML layers designed by Premiere Technologies Inc. The demonstration can be found at www.premierecomm.com/layers/.

In the introduction to our June 24, 1997, cover story, "MMX Means Business," we mistakenly stated that the Dell Dimension XPS M200s uses the 430TX PCI chip set. It uses the 430VX.

New Era of Video Editing," why did you use a video of a young woman having two guns held to her head for your tests? I am disturbed by your display of such an image in an era where violence in general, and especially toward women, is a great problem in our society.

FRANK MARKERT
via the Internet

ALTERNATIVE OS

I was very pleased to find the article "Leaning Toward Linux" (PC Tech, July 1997). I have been disappointed in the past at the lack of interest you have shown toward Linux, and this article indicates to me that this trend might be changing. I find *PC Magazine* to be an interesting and informative publication, and I believe that broadening its scope to include Linux could only enhance its image. I'm even more excited by your promise of future articles involving such subjects as the X Window system.

ETHAN BLANTON
via the Internet

I'm happy to see *PC Magazine* recognize Linux as a viable OS. Linux never seems to get the press that Windows 3.x, 95, and NT have, which strikes me as somewhat odd since Linux is arguably the fastest OS for the x86 architecture. Each OS has its advantages and disadvantages. Linux and other Unix-based operating systems are much more suited for Internet-related tasks, as many hosts on the Internet have found. I certainly hope that you run more articles on alternatives to Windows.

BRIAN MERRELL
via the Internet

MY MOUSE WORKS

I have to agree with the Second Looks article "Avoiding a Windows NT Mousetrap" (May

6, 1997). It used to surprise me how frustrated and impatient I would get when I used my generic mouse before downloading the Windows NT-compatible MouseWorks 5.02. When using Netscape Navigator, I can go to the next and previous pages more easily and without the hassles from the device. MouseWorks has saved me time and has made many programs more enjoyable to use.

MICHELLE GUZMAN-ROBERTS
Naples, Italy

ILLUSTRATING CANVAS

Your April 22, 1997, review of graphics software ("The PC Palette: Illustration") provided an inaccurate description of Canvas 5. The review did not mention the advantages of working with a fully integrated graphics application versus modular graphics suites. Canvas 5 can handle desktop publishing, illustration, image editing, and presentation tasks all in one application.

I also disagree with *PC Magazine's* assertion that Canvas can't move files seamlessly between presentation, publication, and illustration formats. By using Canvas, you can design a log in the illustration mode and literally drag and drop it into either a presentation or publication document.

The review did praise programs that offer OLE, which supposedly lets users switch between graphics applications. The perception that modular programs perform seamlessly through OLE is an old wives' tale. These standalone applications do not communicate well. And OLE requires more memory than switching between modes within Canvas.

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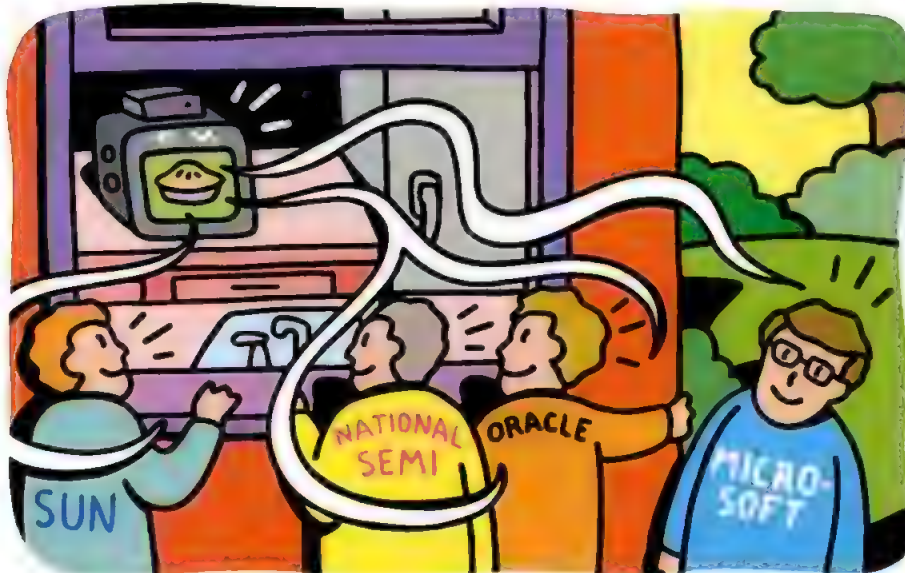
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Trends

The Lure of the Low End

Inexpensive TVs, phones, and terminals get big backers.



Some of the biggest players around are setting their sights resolutely on an unlikely market: the low end. Despite the inauspicious debuts of devices such as network computers, Web televisions, Internet phones, and information appliances, Microsoft, Oracle, Sun Microsystems, and other companies are placing huge bets on them.

After spending two years ridiculing the concept of stripped-down, diskless network computers, Microsoft is promoting "Windows-based Terminals" (WBTs), which sound an awful lot like network computers. At the company's recent Analyst Summit 97, CEO Bill Gates reinforced recent comments pointing to a reversal of his stance on inexpensive terminal-like devices.

"If you have a very light user you can actually move those things to the center," Gates said. "You don't need to have a disk or a browser or anything all that powerful on a client. Even a

386 machine is more than adequate to take, say, a video protocol and display it."

According to Gates, Microsoft's strategy for the ultrathin client is to produce software to work on WBTs. The key components due from Microsoft are a new version of Windows NT, dubbed Hydra, and "superthin-client software." According to Gates, Hydra will be a "multiuser server core that hosts multiple, simultaneous client sessions on Windows NT Server for both Windows-based and non-Windows-based desktops."

Gates' reversal on ultrathin clients has coincided with a new industry focus on "information appliances." Sun Microsystems is acquiring the small start-up Diba, which develops under-\$300 Internet- and Java-enabled appliances. Among its products are a Web browser that hooks up to a TV, a home device for banking and brokerage services, a phone that integrates e-mail and fax, a personal-travel de-

vice, and a set-top box. Sun's move follows on the heels of Oracle's recent purchase of Netscape's information appliance division Navio and Microsoft's acquisition of WebTV.

The lure of the low end is bringing changes in semiconductors, too. National Semiconductor has agreed to acquire Cyrix in the interest of producing processors for low-cost Internet-browsing devices, such as network computers and handheld PCs. Cyrix's MediaGX was a selling point: A single chip integrates graphics, audio, and system-logic functions, eliminating the need for extraneous peripherals.

National Semiconductor's CEO, Brian Halla, says the company intends for the Cyrix acquisition to give it "the building blocks to provide system-on-a-chip solutions for sub-\$500 PCs and a broad range of low-cost information appliances."

THE SUCCESS LOOP

Historically, the PC industry has fueled its own considerable momentum by setting the technology bar ever higher. Chips, operating systems, and hardware designs have leaptfrogged each other in what Microsoft veterans like to call a "success loop."

Does the growing attraction of the low end defy that history as it brings about acquisitions worth billions and plans for all kinds of stripped-down system-level hardware and software? Both the corporate and the consumer markets for many low-end solutions have had unglamorous beginnings. Network computers have yet to take off; Navio and WebTV struggled before Oracle's and Microsoft's acquisitions; and Internet phones aren't ubiquitous.

Hope springs eternal, though. Case in point: At Oracle's launch event for its new database Oracle8, CEO Larry Ellison was asked how his company could continue to back network computers when they had yet to become popular. His response: "That's like asking the Wright brothers how they could view air travel as strategic when they had no passengers."—*Sebastian Rupley*

Strategic Moves

Last summer 1997, four of the world's leading "information appliance" and network computer makers announced plans to acquire or merge with each other.



Caring for Your Nest Egg Online

The "emerging affluent" head for the Web.

Are you in a fiscal fix? If your finances are too complex to manage yourself but not substantial enough to justify retaining a full-service firm such as Merrill Lynch or Smith Barney, you could be a perfect candidate for online financial management.

Forrester Research recently spoke with dozens of full-service brokers, banks, and insurance, mutual-fund, and software companies on their plans for online services. It concluded that the "emerging affluent" are underserved by conventional financial services and are likely to turn to the Web.

Exactly who are these consumers? They are age 25 to 44, earn \$50,000 to \$100,000 annually, and have a median net worth of \$139,600. Mr. or Ms. Emerging Affluent has assets across a range of financial products, including checking and retirement accounts, life insurance, savings bonds, stocks, CDs, mutual funds, and bonds. The Affluent household's balance sheet also contains a variety of debts, including those for a home mortgage, loans, and credit cards.

To manage this kind of portfolio, online consumers will need Web-based software that gathers and consolidates data from multiple financial institutions, assesses their portfolios' performance, and offers personalized advice on how to increase assets and manage debt. They'll also want to make online transactions instantaneously.



Microsoft got the ball rolling with Open Financial Connectivity (OFC), protocols for handling Internet banking and bill payment. This year, OFC should expand to investments. Forrester envisions that financial institutions will offer a new kind of soup-to-nuts service—an "online management account"—that will go for an annual fee of \$250 to \$500 or a commission.

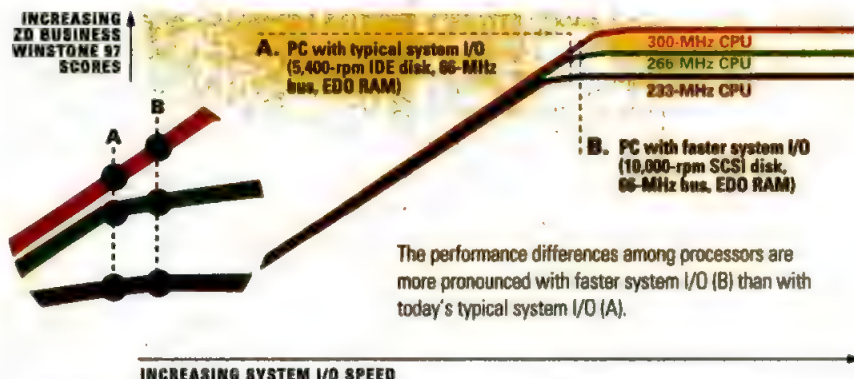
But the transition won't happen overnight. According to Forrester, "For most institutions, progress will wait until leadership passes to younger executives who use PCs on a daily basis." And that could take about a decade.—Carol Levin



Vanishing Megahertz

IF YOU'RE THINKING ABOUT PURCHASING A computer based on Intel's new Pentium II 300-MHz microprocessor, there are a few things that you should know before you dive in. While testing 12 of the latest x86 processors for this issue's feature "The Best CPU for Your Next PC," PC Labs learned that the 300-MHz processor

tribute these disappointing gains partly to slow ECC memory. More at fault, however, was the inadequate speed of the I/O system: the 66-MHz system bus, the 5,400-rpm IDE hard disk, and the 528-MBps (maximum) memory subsystem. When we alleviated one of the bottlenecks, replacing the 5,400-rpm IDE hard disk with a 10,000-



Figures for points A and B are PC Labs test results; all other figures are projections.

is only negligibly faster than the 266-MHz version, paralleling what we discovered a year ago while comparing the 200-MHz and the 166-MHz Pentium microprocessors.

In each case, we attribute the results not to the processor itself but, in large part, to the computer's slow I/O system—the hard disk, memory, and system bus. The situation is important to remember, because all too often, PC buyers pay substantial premiums for the few extra clock cycles that Intel has been able to eke out of the latest chip. According to Michael Slater—the author of the feature story and editor-in-chief of *Microprocessor Report*, a leading industry newsletter—Intel is pushing the industry hard to develop advanced system I/O technology that can support faster CPUs.

PC Labs' anecdotal testing confirmed this idea. In running our Business Winstone 97 tests under Windows NT with 64MB of RAM, we found a 4.8 percent performance difference between Pentium II 233-MHz and 266-MHz systems, but only a 1.0 percent difference between 266-MHz and 300-MHz systems. We at-

tribute these disappointing gains partly to slow ECC memory. More at fault, however, was the inadequate speed of the I/O system: the 66-MHz system bus, the 5,400-rpm IDE hard disk, and the 528-MBps (maximum) memory subsystem. When we alleviated one of the bottlenecks, replacing the 5,400-rpm IDE hard disk with a 10,000-

rpm Ultra Wide SCSI Seagate Cheetah, the differences widened to 6.3 percent between a 233-MHz and a 266-MHz CPU and to 2.5 percent between a 266-MHz and a 300-MHz CPU. With the latest Pentium II offering, Intel has surpassed the level of the currently available system I/O technologies. If you plan to pay extra for a system with the new 300-MHz Pentium II (Intel sells the chip for \$851; the 266-MHz version costs \$669), make sure you surround the CPU with the most advanced I/O technologies available in order to take as much advantage of the processor as possible. As this issue's cover story evaluation of eight 300-MHz systems concludes, the faster CPUs perform best when supported by advanced I/O systems.

Soon the industry will offer more advanced system I/O methods, and at reasonable prices—methods such as Rambus's and SDRAM's high-speed memory technologies, 100-MHz system buses, faster hard disks, and more sophisticated disk subsystems, such as Intelligent I/O. Perhaps only then should buyers take advantage of the latest and greatest CPUs.—S. Jae Yang

Next Year's Digital Camera

Intel promises low cost and ease of use.

Digital cameras are about to get some much-needed exposure. With the support of a cadre of hardware and software companies, Intel is teaming up with Hewlett-Packard and Microsoft to make them less expensive PC peripherals. The move, says Intel, will make the digital camera as popular as the printer, the keyboard, and the mouse.

Intel and its partners have developed a new digital camera architecture, dubbed Portable PC Camera '98 Design Guideline, that offloads the device's complex functions onto the PC—preferably a PC with Intel's Pentium MMX or Pentium II processor. By transferring image compression, 8- to 24-bit interpolation, and image enhancement to the PC, manufacturers will minimize the hardware the camera needs, substantially reduce the complexity of the camera's design and built-in "logic," and shave costs. So far the spec's sup-

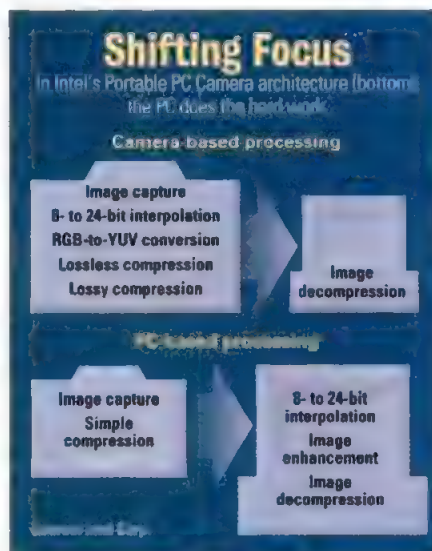
porters include Acer, Epson, Kodak, Polaroid, and other camera makers.

Price tags for the new devices, which Intel expects will be available in the second quarter of next year, will reflect those savings. Today, a digital camera that produces an image with 640-by-480 resolution costs around \$400. Intel

expects that an equivalent camera that adheres to the new design will be less than \$300.

The new specification also attempts to solve the problems with PC connectivity, file formats, and drivers that hinder user-friendliness. For instance, the spec recommends connecting cameras to PCs via Universal Serial Bus, which offers a faster data-transfer rate than the conventional serial port. It also calls for using the file format FlashPix, which supports multiple resolutions, and addresses color-image capture, power consumption, battery life, image downloading, and electronic film.

The players backing Portable PC Camera hope it'll bring a needed boost to the digital camera market, in which sales are proving elusive. For example, Kodak—a big investor in digital cameras—is struggling in that market but has few doubts about what's needed to speed up consumers' acceptance. "We're combining the power of Intel processing with Kodak's industry-leading imaging technology," says Bob Unterberger, president of Digital & Applied Imaging at Kodak. "This is key to providing easy access to high-quality imaging in order to grow the digital photography market."—Angela Hickman



JAKE KIRCHNER

Windows 98: The Whining Has Already Begun

We're still many months away from seeing a final version of Windows 98—until recently known as Memphis—but the carping, complaining, and whining are already in full breeze.

No, I'm not talking about the reaction of the millions of users who will have to decide whether to upgrade. I'm talking about my fellow journalists and the assorted pundits and analysts who are already indicating their considerable distaste for the new operating system. Not that most of them have seen Windows 98. But then most journalists, pundits, and analysts don't care about Windows or any other software or hardware product anyway. What they care about is the spin.

You'll remember that two years ago, in the months preceding the launch of Windows 95, most of what you read about the product concerned "the hype" surrounding its introduction. Much of the rest of the coverage was directed at decrying all that press hype. Among this swirl of bad vibes was the oft-stated opinion that Windows 95 was not a very compelling upgrade and that finicky corporate users would opt for a coming version of Windows NT. The implication—the spin—was that Microsoft had fallen on its face with Win 95.

These naysayers never made clear why Microsoft should care if corporate buyers chose the much more expensive Win NT, or why Microsoft would be devastated if "only" a few tens of millions of users upgraded. And by any measure, Windows 95 has been the most successful operating system ever.

Windows 98 may very well surpass Windows 95 in units shipped,



although that doesn't mean it will be a good product. From our testing we know the new OS will bring a radical change to the interface and will have enough performance enhancements to be worth consideration; its true value will be determined through more testing as it gets closer to shipping. But the pundits are already in a tizzy.

To hear their opinions, Windows 98 is either too early or too late; Microsoft took too long to get it to market or rushed its development. It's either disastrously late for the coming Christmas sales season or

too soon after the last one. The product is either too big a change from Win 95 or not enough of an advance.

In this business there's room for many opinions. I just wish that in this instance there were a bit more heat and a lot less smoke, so that potential Windows 98 users could make up their own minds a little more easily.

A good software company upgrades its products frequently enough to keep advancing its customers' capabilities, but not so frequently that it overburdens their resources. To me, Windows 98 seems to hit the mark just about right for a nonmajor upgrade, but this hardly means that everyone needs to rush out and buy it. When auto makers add new features to cars—such as air bags or more efficient engines—no one expects that every car owner will rush out to buy a new model. Some no doubt do, but more importantly, every buyer down the road will benefit from the new technologies.

As for Windows 98, ignore the hot air of the spin masters, read the product reviews carefully, and make up your own mind.

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Expanding Horizons

The 300-MHz Pentium II processor is just now reaching the market, and though it was initially priced at a whopping \$1,981, Intel has had a change of heart and announced a price cut that allows for 300-MHz mainstream desktops. These are typically equipped with Intel's new 440LX AGP chip set, a performance-enhancing technology designed specifically for the Pentium II architecture.

With this issue's cover story ("The Two Faces of 300 MHz"), we review the first wave of 300-MHz Pentium II desktops and workstations. Two smaller manufacturers have built their own systems around Intel's fastest processor to date. Now, Unicent Technologies (800-628-4888,

www.unicent.com) is offering a brand-new 440LX-based desktop, and DTK Computer (800-289-2385, www.dtkcomputer.com) has built a Windows NT Workstation around the previously existing 440FX chip set.

Unicent's **Avanta 300XLP** (\$3,099 direct) is a 300-MHz Pentium II desktop intended for business and power users. The machine ships with 64MB of SDRAM memory, a 6.5GB Ultra ATA IDE hard disk, a 24X Toshiba CD-ROM drive, and the Matrox Millennium II AGP video card. The

440LX chip set is the first to support Ultra ATA drives (which use the ultra DMA protocol), faster data throughput, and AGP (Advanced Graphics Port) cards. AGP improves performance by taking graphics off the PCI bus.

Available in both desktop and

inch flat-screen monitor, and two USB ports.

Although DTK Computer's 440LX system was not yet ready as we went to press, the company did have the **DTK APRI-74M/K300** (\$4,500 street), a 300-MHz Pentium II workstation based on the tried-and-true 440FX chip set. This ATX-based system contains only high-end hardware. Its 4.3GB Ultra Wide SCSI Seagate Cheetah hard disk spins at 10,000 rpm. Its ATAPI CD-ROM drive from Toshiba runs at 24X speed. Its leading-edge Matrox Millennium II graphics card is equipped with 8MB of VRAM. A Creative Labs sound card, 64MB of EDO RAM system

memory, and a pair of speakers are included as well. In our first review of Pentium II desktops ("Pentium: Part II," June 10, 1997), a similarly equipped 266-MHz DTK machine was one of the leading performers on our hard disk- and CD-ROM-based benchmark tests.—Cade Metz



300-MHz POWER: Systems from Unicent (top left) and DTK Computer (above).

mini-tower configurations, the Avanta is also equipped with an Ensoniq PCI wavetable sound card, a 33.6-Kbps U.S. Robotics telephony modem, a pair of amplified external speakers, a 17-

UPGRADES

Stepping Up to MMX with Evergreen's MxPro

Evergreen Technologies (888-607-7333, www.everttech.com) has one of the fastest upgrade processors on the market. A CPU upgrade based on AMD's K6 chip, the **Evergreen MxPro Processor for Pentiums** equips low-end desktops with MMX technology, and the high-end 233-MHz version also raises performance to the level of a 200-MHz classic Pentium.

Before attempting a refit with either the 166-, 200-, or 233-MHz MxPro upgrades (\$199, \$349, and \$499, respectively), you should confirm that your PC is a candidate for an MxPro upgrade; the list, which only includes Pentium systems running at 75 MHz or higher, can be viewed at Evergreen's Web site or can be obtained via telephone.

At PC Magazine Labs, we used the 233-MHz chip to augment the performance of a Gateway 2000 Pentium/75 mini-tower (supplied by Evergreen). Prior to the upgrade, this Windows 95 machine—equipped with an Intel Advanced/ZP "Zappa" motherboard, the Intel 430FX chip set, a 5,200-rpm Western Digital Caviar hard disk, and a Matrox Millennium graphics card with 2MB of

VRAM—scored an 18.5 on our ZD Business Winstone benchmark test, a 132 on ZD CPUmark₁₆, and a 131 on ZD CPUmark₃₂.

Installing the MxPro upgrade took less than 20 minutes. After booting the Gateway from an included disk, we used Evergreen's Install software to identify existing hardware and verify that an upgrade could be successfully performed. Seven common Socket5 and Socket7 motherboards are supported. After its system check, Install saves your extant BIOS to disk, then writes a new version to the motherboard.

With the BIOS upgrade complete, we powered the system down and removed its existing CPU. We then attached a cooling fan—which Evergreen ships with each MxPro—to the upgrade chip before inserting the entire assembly into our open socket.

At this point, the system bus still ran at 50 MHz and the processor reached speeds of only 174 MHz. In order to reach the maximum level of performance, we had to adjust the motherboard's jumper or DIP-switch settings. The MxPro manu-

al provides the appropriate settings for each of the seven supported Intel motherboards. These adjustments made, the system bus ratcheted up to 66 MHz and the processor reached its full 233-MHz potential.

With its new hardware and BIOS, the Gateway produced a Business Winstone score of 38.5 and CPUmark₁₆ and CPUmark₃₂ scores of 347 and 357, respectively. Such performance is comparable to that of a 200-MHz classic Pentium—not a 233-MHz K6. In a recent review ("An MMX Kick in the Pants," April 8, 1997), we upgraded a Pentium/90 machine with a 150-MHz MMX OverDrive. Winstone performance, which began at 21, rose to 26.

Though Intel did not send us hardware for testing as we went to press, the company (800-538-3373, www.intel.com) recently added 180- and 200-MHz **Pentium OverDrive Processors with MMX Technology** to its line of upgrade chips. The 180-MHz version (\$299) can be used with 90-, 120-, and 150-MHz Pentium-based PCs; the 200-MHz CPU (\$349) upgrade can be used with 100-, 133-, and 166-MHz Pentium systems.—CM

REFERENCE

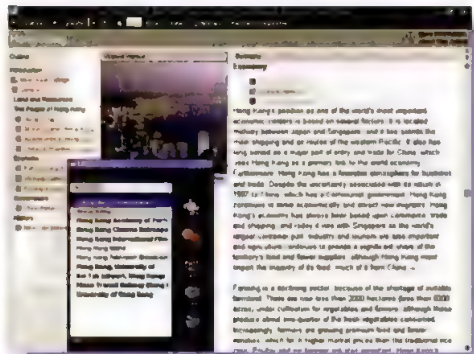
Look It Up and Learn

It's that time of year again. Arriving just in time for the back-to-school season are the latest updates to CD-ROM references and encyclopedias.

Celebrating its fifth anniversary is Microsoft Corp.'s **Encarta Encyclopedia 98** (800-426-9400, www.microsoft.com). The dual-disk Deluxe Edition (\$80 street) of this popular encyclopedia has added several new features and new content. It has more than 32,000 articles and a total of 16,000 media elements; for the hearing impaired, closed captioning is now available. New online features include automatic, free online updates and the ability

to generate collections of Web links based on your own search filter. The most powerful new feature, though, is the Research Organizer, which uses the index-card paradigm to keep track of citations while collecting information from various sources.

Also new from Microsoft is the revised **Microsoft Bookshelf 98** CD-ROM reference library, which packs ten valuable reference tools—including versions of Encarta 98 Desk Encyclopedia, the



COMPREHENSIVE DETAILS: Microsoft's Encarta.

Encarta 98 Desk World Atlas, The Original Roget's Thesaurus of English Words and Phrases, and The Columbia Dictionary of Quotations—onto a single CD that can be used with either Microsoft Office 95 or 97. The inter-

face has been simplified, providing easy access to the program's key features directly from within any application. Other useful additions are built-in parental controls and QuickFootnote, which automatically creates footnotes and citations when working in Microsoft Word or Works.

From The Learning Company (800-227-5609, www.learningco.com) comes **Compton's Interactive Encyclopedia Deluxe Edition 1998**. This two-disk set (\$64.95) provides free monthly updates through September 1998 (at which time there will be an offer to upgrade to Compton's 99). The encyclopedia includes more than 38,000 articles, 450 U.S. and world maps, and an integrated dictionary and thesaurus. There are also over 16,000

photos, 150 videos and animations, and 20 hours of audio clips. In addition to using a local resources guide, a virtual notebook, and a multimedia presentation tool, you can pose research questions to Compton's staff librarians,

who will recommend books, pictures, maps, and online resources within 48 hours.

Challenging Microsoft's Bookshelf is The Learning Company's **The Complete Reference Collection 1998** edition. This \$44.95 CD-ROM includes such tools as a concise version of Compton's Encyclopedia, Webster's New World Dictionary and The-saurus, Compton's World Atlas, and Merriam-Webster's Concise Handbook for Writers.

Encyclopedia Britannica (800-474-8503, www.eb.com) steps up to the plate with the \$150 **Britannica CD 98 Multimedia Edition**. Featuring a new graphical interface and a search engine that accepts intuitive natural-language queries, Britannica has over 72,000 articles and 1,100 multimedia elements—including pictures, audio, video, maps, and animations. You'll also find 15,000 Internet links, Merriam-Webster's Collegiate Dictionary, and the ability to dynamically generate graphs and charts.

You can also expect to find updated encyclopedias from Grolier Interactive and World Book.—*Melissa J. Perenson*

IMAGING

Panoramas in 3-D

As anyone standing atop structures like the Eiffel Tower or Empire State Building can attest, there's nothing like the perspective offered by a panoramic view. Now you can create navigable 360-degree panoramic images from standard-size or panoramic still images with software from PictureWorks Technology (800-303-5400, www.pictureworks.com) and Live Picture (800-724-7900, www.livepicture.com).

PictureWorks' \$99.95 **Spin Panorama** is the first Windows product that can be used to create QuickTime VR 1.0 movies. Spin Panorama walks you through the process of stitching together multiple, overlapping still images into a seamless 360-degree movie or a

super-wide-angle still picture. Both JPEG and .BMP files are supported for importing still images and exporting wide-angle composites. You set common reference points between two overlapping images and then merge them; adjustments are made automatically to correct alignment or lighting differences. The resulting panoramic movie can be viewed with the QuickTime VR player. Spin Panorama uses Cinepak compression to produce files that are sized between 100K and 300K.

Live Picture offers an alternative to working in the QuickTime VR format. Based on Live Picture's RealSpace imaging technology, the company's **PhotoVista** software (\$99 introductory price)



TAKE IN THE VIEW: Stitching together images to create a panorama with Live Picture's PhotoVista.

easily stitches photos together to create a 360-degree panoramic image optimized for use on the Web. The automatic stitching process uses pattern-recognition techniques to match adjacent pairs of images; then the software smooths the color and compensates for exposure variance. The resulting panoramic images are less than 100K in size and

can be streamed into the proprietary RealSpace Viewer, which allows you to interact with the image even before it has finished loading.

As an alternative, you can place PhotoVista panoramas directly into HTML pages. Embedded functionality includes the ability

to generate text files in VRML, which enables users to link panoramas, add hot spots to other content, or incorporate 3-D objects, animation, audio, and video. The software supports importing .BMP, JPEG, .GIF, and .PICT images. There's also support for wrapping the panorama around a cube or cylinder, and configurable camera lens views.—*MJP*

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No wonder an IDC/ACNielsen survey of computer owners showed Gateway had the highest brand loyalty of any computer maker in the U.S. home market, even better than those good old boys with the fruit logo*.

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*Based on percentage of computer owners planning to buy another computer of the same brand as they currently own between 11/1/96 and 7/31/97.



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- Modular 6X min/11X max CD-ROM Drive
- Modular 3.5" Diskette Drive
- Zoomed Video
- 1.3GB Hard Drive
- 16-Bit Sound & Stereo Speakers
- NiMH Battery & AC Pack
- 85-Key MS Windows 95 Keyboard
- EZ Pad® Pointing Device
- Casual Carrying Case
- Microsoft® Windows 95
- MS Works 95
- Gateway Gold Service & Support for Portable PCs

\$1899 As low as * \$66/mo.

2300LS

- 12.1" SVGA TFT Color Display
- Intel 150MHz Pentium® Processor with MMX™ Technology
- 32MB SDRAM (expandable to 192MB)
- 256K Pipelined Burst Cache
- 1.15MB Integrated Video RAM
- Modular 8X min/11X max CD-ROM Drive
- Modular 3.5" Diskette Drive
- USB Ports & Zoomed Video
- NTSC/PAL Video Output
- 3GB Hard Drive
- 16-Bit Sound & Stereo Speakers
- PCMCIA Data/14.4 Fax Modem**
- 12-Cell Li-Ion Battery & AC Pack
- 85-Key MS Windows 95 Keyboard
- EZ Pad Pointing Device
- Casual Carrying Case
- MS Windows 95 & MS Office 97, Small Business Edition plus Encarta® 97
- Gateway Gold Service & Support for Portable PCs

\$3849 As low as * \$134/mo.

9100XL

- ▶ 13.3" XGA TFT Color Display
- Intel 166MHz Pentium Processor with MMX Technology
- 64MB SDRAM (expandable to 192MB)
- 256K Pipelined Burst Cache
- ▶ 4MB EDO Video RAM (1280 x1024 external)
- USB Ports & Zoomed Video
- ▶ Removable Combo 8X min/11X max CD-ROM & 3.5" Diskette Drive
- Two 12-Cell Lithium Ion Batteries & AC Pack
- NTSC/PAL Video Input & Output
- 5GB Hard Drive
- 16-Bit Wavetable Sound & Stereo Speakers
- PCMCIA Modem with x2™ Technology**
- 88-Key MS Windows 95 Keyboard
- EZ Pad Pointing Device
- Deluxe Carrying Case
- MS Windows 95
- MS Office 97, Small Business Edition plus Encarta 97
- Gateway Gold Service & Support for Portable PCs

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GATEWAY2000

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Value Bigger Than All Outdoors

Computing in the den, family room, small office — no matter where you need a PC, Gateway can fill the bill.

GATEWAY™ Destination Big Screen PC/TVs

The Destination system pioneered group computing thanks to a 31-inch monitor, wireless keyboard and Field Mouse remote. With the heart of a computer and options like the **Pentium® II** processor and DVD-ROM drive, the Destination system can do anything a PC can do. With a click of the mouse button, it can also do anything a conventional television can do.

Gateway G-Series and GP-Series PCs

No sense making things complicated. Give customers fresh technology at great prices. Sticking to that philosophy has built Gateway into what it is today.

The G-Series is classic Gateway: Find out what customers want, go find it and offer it at prices people can afford. That means the latest multimedia, including MMX technology across the line and the new digital bad boy, DVD. Fresh technology at great prices. The philosophy has made Gateway a force in the home market.

The GP-Series delivers that same fresh technology to the small office/home office. Options like Intel's **Pentium II** processors, massive storage and productivity software let one GP-Series PC do many things.

Gateway Destination™

Big Screen PC/TVs

D6-300XL

- Intel® 300MHz Pentium® II Processor with 512K Cache
- 64MB EDO DRAM
- Destination 31" VGA Monitor
- 2MB Graphics Accelerator w/ Cable-Ready TV Tuner
- 6.4GB 10ms EIDE Hard Drive
- ▶ DVD-ROM Drive & DVD Decoder Card
- 3.5" Diskette Drive
- ▶ EasyPhoto Drive™ Photo Scanner
- Ensoniq® Wavetable Audio
- ▶ harman/kardon® High-Fidelity Sound System
- TelePath® Modem for Windows with x2™ Technology**
- 7-Bay Charcoal-Colored PC Case
- Wireless Keyboard w/ Integrated EZ Pad® Pointing Device
- Wireless Field Mouse® Remote
- Microsoft® Windows® 95
- Home Software Gallery
- Gateway Gold™ Service & Support* for Big Screen PC/TVs

\$4699 As low as *\$163/mo.

*The Destination 31-inch monitor is covered by a one-year limited warranty. Call or write for a free copy.



Gateway GP-Series PCs
for the Office Professional

GP5-166

- Intel 166MHz Pentium® Processor with MMX™ Technology
- 32MB SDRAM
- 512K Pipelined Burst Cache
- CrystalScan®500 .28 Screen Pitch 15" Monitor (13.9" viewable)
- 2MB 3-D 64-Bit PCI Graphics
- 2GB 10ms Ultra ATA Hard Drive
- 12X min/16X max CD-ROM & 3.5" Diskette Drives
- Desktop Case
- 104* Keyboard & MS® IntelliMouse™
- MS Windows 95 & MS Office 97, Small Business Edition plus Encarta® 97
- Gateway Gold Service & Support for Desktop PCs

\$1449 Business Lease* \$54/mo.

GP6-266

- Intel 266MHz Pentium II Processor with 512K Cache
- 64MB EDO DRAM
- ▶ EV900 .26 Screen Pitch 19" Monitor (18" viewable)
- 4MB 3-D 64-Bit PCI Graphics
- 6.4GB 10ms Ultra ATA Hard Drive
- 12X min/24X max CD-ROM & 3.5" Diskette Drives
- Mid-Tower Case
- 104* Keyboard & MS IntelliMouse
- MS Windows 95 & MS Office 97, Small Business Edition plus Encarta 97
- Gateway Gold Service & Support for Desktop PCs

\$2999 Business Lease* \$110/mo.

Gateway G-Series
Multimedia PCs for the Home

GD-166

- Intel 166MHz Pentium Processor with MMX Technology
- 16MB SDRAM
- 512K Pipelined Burst Cache
- CrystalScan500 .28 Screen Pitch 15" Monitor (13.9" viewable)
- 2MB 3-D 64-Bit PCI Graphics
- 2GB 10ms Ultra ATA Hard Drive
- 12X min/16X max CD-ROM & 3.5" Diskette Drives
- Ensoniq Wavetable Audio
- Altec™ Lansing ACS-41 Speakers
- TelePath Modem for Windows with x2 Technology™
- Desktop Case
- 104* Keyboard & Microsoft® IntelliMouse
- MS Windows 95 & Home Software Bundle
- ▶ Color Ink Jet Printer
- Gateway Gold Service & Support for Desktop PCs

\$1599 As low as* \$56/mo.

GD-300M2

- Intel 300MHz Pentium® II Processor with 512K Cache
- 64MB EDO DRAM
- ▶ EV900 .26 Screen Pitch 19" Monitor (18" viewable)
- 4MB 3-D 64-Bit PCI Graphics
- TV/FM Tuner Card
- 6.4GB 10ms Ultra ATA Hard Drive
- ▶ DVD-ROM Drive & DVD Decoder Card
- 3.5" Diskette Drive
- Ensoniq Wavetable Audio
- ▶ Boston Acoustics® MicroMedia™ 3-Piece Speaker System
- TelePath Modem for Windows with x2 Technology™
- Tower Case
- 104* Keyboard & MS IntelliMouse
- MS Windows 95 & MS Office 97, Small Business Edition plus Encarta 97
- MMX Technology-Enhanced Software
- Gateway Gold Service & Support for Desktop PCs

\$3799 As low as* \$132/mo.

Please see back page for more configurations.



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Gateway G-Series and GP-Series Computers For The Home and Office

Barn Burnin' Values

Get more for your money with GATEWAY® PCs!

Gateway G-Series Multimedia PC

GE-200

- Intel® 233MHz Pentium® II Processor with 512K Cache
- 32MB EDO DRAM
- CrystalScan®700 .28 Screen Pitch 17" Monitor (15.9" viewable)
- 4MB 3-D 64-Bit PCI Graphics
- 4GB 10ms Ultra ATA Hard Drive
- 12X min/24X max CD-ROM & 3.5" Diskette Drives
- Ensoniq® Wavetable Audio
- ▶ Boston Acoustics® MicroMedia™ 3-Piece Speaker System
- TelePath® Modem for Windows, with x2™ Technology™
- Mid-Tower Case
- 104+ Keyboard & Microsoft® IntelliMouse™
- MS® Windows® 95 & MS Office 97, Small Business Edition plus Encarta® 97
- MMX™ Technology-Enhanced Software
- Gateway Gold™ Service & Support for Desktop PCs

\$2549 As low as* \$89/mo.

Gateway Destination™ Big Screen PC/TV

D5-200

- Intel 200MHz Pentium® Processor with MMX Technology
- 32MB SDRAM
- 512K Pipelined Burst Cache
- Destination 31" VGA Monitor
- 2MB Graphics Accelerator with Cable-Ready TV Tuner
- 4GB 10ms Ultra ATA Hard Drive
- ▶ DVD-ROM Drive & DVD Decoder Card
- 3.5" Diskette Drive
- Ensoniq Wavetable Audio
- ▶ Boston Acoustics MicroMedia 3-Piece Speaker System
- TelePath Modem for Windows with x2 Technology™
- 7-Bay Charcoal-Colored PC Case
- Wireless Keyboard w/ Integrated EZ Pad® Pointing Device
- Wireless Field Mouse® Remote
- MS Windows 95
- Home Software Gallery
- Gateway Gold Service & Support* for Big Screen PC/TVs

\$2999 As low as* \$104/mo.

Gateway GP-Series Professional PC

GP6-266

- Intel 266MHz Pentium II Processor with 512K Cache
- 64MB EDO DRAM
- ▶ EV900 .26 Screen Pitch 19" Monitor (18" viewable)
- 4MB 3-D 64-Bit PCI Graphics
- 6.4GB 10ms Ultra ATA Hard Drive
- 12X min/24X max CD-ROM & 3.5" Diskette Drives
- Mid-Tower Case
- 104+ Keyboard & MS IntelliMouse
- MS Windows 95
- MS Office 97, Small Business Edition plus Encarta 97
- Gateway Gold Service & Support for Desktop PCs

\$2999 Business Lease* \$110/mo.

Gateway Solo™ Portable PC

9100XL

- ▶ 13.3" XGA TFT Color Display
- Intel 166MHz Pentium Processor with MMX Technology
- 64MB SDRAM (expandable to 192MB)
- 256K Pipelined Burst Cache
- ▶ 4MB EDO Video RAM (1280 x 1024 external)
- USB Ports & Zoomed Video
- ▶ Removable Combo 8X min/11X max CD-ROM & 3.5" Diskette Drive
- Two 12-Cell Lithium Ion Batteries & AC Pack
- NTSC/PAL Video Input & Output
- 5GB Hard Drive
- Premium 16-Bit Wavetable Sound & Stereo Speakers
- PCMCIA Modem with x2 Technology™
- 88-Key MS Windows 95 Keyboard
- EZ Pad Pointing Device
- Deluxe Carrying Case
- MS Windows 95
- MS Office 97, Small Business Edition plus Encarta 97
- Gateway Gold Service & Support for Portable PCs

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Upgrades

Sold only with the purchase of a system.

Desktop Upgrades

- DVD-ROM, DVD Decoder Board and DVD Media Sampler \$419
- Boston Acoustics® MicroMedia™ 3-Piece Speaker System *(upgrade from PCs that include Altec™ Lansing ACS-41 Speakers)* \$75
- Iomega® Internal ZIP™ 100MB Drive \$99 *(includes two 100MB cartridges)*
- TR4 IDE 4GB Tape Backup Unit \$199
- MS® Windows NT® 4.0 Upgrade \$99 *(upgrade from PCs that include MS Windows® 95)*

Portable PC Upgrades

- Gateway Solo™ Mini Docking Station \$199
- Gateway Solo Docking Station \$599
- 33.6 Data™/14.4 Fax Modem \$200
- Extra 2300/9100 12-Cell Lithium Ion Battery \$200

*Maximum data transfer rate dependent on certain variables including particular modems with which you are communicating, telephone lines, communications software and communications protocols

Destination™ Big Screen PC/TV Upgrades

- harman/kardon® High-Fidelity Sound System
Seven-piece Dolby® Pro Logic® Surround Sound system including AVR-10 audio/video receiver with remote, subwoofer, center channel, and four satellites. *(upgrade from Boston Acoustics MicroMedia 3-Piece Speaker System)* \$400
- EasyPhoto Drive™ Photo Scanner Upgrade \$149
- Additional Destination 31-Inch VGA Color Monitor \$999 *(Call for details.)*

Service & Support for Desktop Systems

GATEWAY GOLD™ PREMIUM

- Extended Three-Year On-Site Agreement** including priority 800 number for access to technical experts.
- At time of system purchase \$99
- Within current on-site service agreement \$129

For our complete line of software and peripherals call GATEWAY™ component add-on sales at 800-846-2080.
Sales Hours: 7am-10pm Weekdays (CT).

**On-site service is available to most locations in the continental United States, Alaska, Hawaii, Puerto Rico and Canada after you and your Gateway technician determine an on-site visit is necessary. On-site service is provided by PC Technology Services, Inc. On-site is not available for any monitor, mouse, keyboard, or portable system. Write or call for a free copy of the on-site service agreement.

Extras

GATEWAY SELECT

Our Gateway Select program lets you know you're getting software that meets or exceeds our standards for quality, value and ease of use.

Software

- Games & Entertainment Pack II Includes Bug!™; DeadLock™; MechWarrior® 2: Mercenaries™; 9™; PitFall: The Mayan Adventure®; SPQR: The Empire's Darkest Hour™; and PC ProPad gaming device. \$99
- Finance Pack II *(U.S. Shipment Only)* Includes Quicken® Deluxe 6; Quicken Financial Planner™ 2; Quicken Family Lawyer™ 7; and Quicken Parents' Guide to Money™. \$69
- Kid's Backpack™ IV Includes Math Blaster®: In Search Of Spot; Freddi Fish™ And The Case Of The Missing Kelp Seeds™; Pajama Sam™ In "No Need To Hide When It's Dark Outside"™ Just Me And My Mom™; and Muppet Treasure Island™. \$59
- Education Bundle Grades K-3 Includes Ultimate Children's Encyclopedia™; Reader Rabbit® 1; Math Rabbit®; Interactive Math Journey™; Reader Rabbit's Interactive Reading Journey® 1; Paint, Write & Play!™; Let's Start Learning!™ and cow-spotted binder. \$99
- Education Bundle Grades 4-8 Includes Super Solvers® Gizmos & Gadgets!®; Super Solvers OutNumbered!®; Student Writing Center™; Logic Quest™; The Oregon Trail®; Ultimate Writing & Creativity Center™ and cow-spotted binder. \$99

Extras

- MS SideWinder™ 3D Pro Joystick \$59
- APC® Back-UPS® Office \$169
- APC 650 Pro UPS \$329
- Epson® PhotoPC™ 500 Digital Camera \$499

Printers *(Each printer includes cable and ink cartridge.)*

- Epson Stylus® Color 400 Ink Jet Printer \$199
- Epson Stylus Color 600 Ink Jet Printer \$299
- Epson Stylus Color 800 Ink Jet Printer \$449
- Hewlett-Packard DeskJet 820Cse Color Printer \$299
- Hewlett-Packard LaserJet 6Lse Laser Printer \$399
- Hewlett-Packard LaserJet 6Pse Laser Printer \$799
- Hewlett-Packard LaserJet 5se Laser Printer \$1049



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Component Add-On Sales 800-846-2080 • Sales Hours: 7am-10pm Weekdays, 8am-8pm Saturdays & Sundays (CT)

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Trends Peripherals

VIDEO ENCODERS

Video Capture Made Easy

Digitizing, editing, and sharing your camcorder tapes just got easier. A new breed of video-capture add-ons, targeted squarely at the home PC user, allows you to import images from any camcorder, VCR,

or television; edit them on the PC; and then insert the clips in video e-mail or on the Web. The packages are also ideal for business users who need to produce their own video-laden multimedia presentations. Unlike traditional video-capture boards, some of these affordable solutions hook up to your PC's parallel port, so there's no need to open the case of your machine.

Omega Corp. (800-697-8833, www.omega.com) will roll out its aggressively priced **Buz Multimedia Producer** (\$200 street) in time

for the holiday season. The package comes with an external box for connecting video sources; the box's JPEG encoder (with a chip set by Zoran) sends the compressed video stream to the included Ultra SCSI adapter card that you install inside your PC. Not coincidentally, the SCSI adapter makes it easy to connect

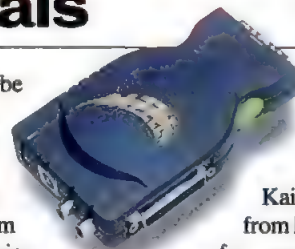
CAPTURE IT: Omega's Buz (above) and LA Vision's Dazzle.

Omega's Zip drive and Jaz drive as well as other storage devices for saving your multimedia creations. The easy-to-use software suite includes MGI Software's VideoWave SE Plus, which lets you edit your video clips and add titles, animations, and interesting effects such as fades and wipes.

The parallel-port video capture add-ons employ an MPEG-1 en-

coder chip set (by C-Cube Microsystems) and attach to your system in seconds.

The new **MPEG Wizard** (\$300 street), from AVerMedia Technologies (800-863-2332, www.aver.com), includes Cinax's i-Film Edit for video editing plus Astound's Studio M for creating multimedia greeting cards, video photo albums, and more. The **Python** (\$350 street), from Videonics (800-338-3348, www.videonics.com), bun-



dles Astound multimedia presentation software and Kai's Power GOO, from MetaCreations, for morphing video stills. LA Vision (888-436-4348, www.la-vision.com) offers the **Dazzle** system (\$300 street price), which bundles the encoder plus the Cinax video editor, Power GOO, Adobe PhotoDeluxe, Astound Studio M, and more. —Jamie M. Bsales

SURGE PROTECTORS

A Place for Power Packs

If you're not going to invest in a UPS (see "The Power Brokers"), at least protect your equipment from electrical surges and spikes with a surge suppressor.

The **APC SurgeArrest Surge Station** series (starting at \$60), from American Power Conversion (800-887-4080, www.apcc.com), has a disk-shaped design that includes eight outlets. The intelligent layout means you won't block the three widely spaced plugs with the bulky transformer bricks so many PC devices use. —JMB



WIRELESS KEYBOARDS

Couch Surfing

With PC/TV and WebTV moving computing into the family room, comfort is becoming just as important as utility. Even though many entertainment-oriented PC devices come with remote keyboards, some are just adequate—and others (like certain WebTV systems) don't come with keyboards at all. Several manufacturers are now producing infrared (IR) keyboards aimed at upgrades for living room machines.

Acer America Corp.'s (800-379-2237, www.acer.com/aac) first-ever IR entry is the **AirKey Keyboard** (\$89). Powered by 2 AA batteries, the AirKey has a maximum line-of-sight operating dis-



POINT AND SHOOT: Wireless keyboards from Casco (above and inset) and Interlink (below right).

tance of 30 feet (up to 20 feet otherwise). The unit has 84 standard keys and a full set of 12 function keys; it weighs just 1.2 pounds. The board also features the AirPoint pointing device, a gamepad-like disk for cursor control that's coupled with two mouse buttons.

The \$69.95 **IR Keypoint Pro** from Casco Products (800-793-6960, www.casco.com) is designed with multimedia in mind. In addition to the 89 standard keys and 12 function keys, the keyboard features 14 programmable keys dedicated to controlling selected Web browser functions and CD-ROM and speaker options. Equipped with a convenient, joystick-like pointing stick, the IR Keypoint Pro has full two-button mouse operation and a

drag key. In addition, it can operate at up to 30 feet from the infrared receiver.

For those who wish to have long-distance laptop comfort, there's the **VersaPoint** keyboard (\$100 street), from Interlink Electronics (800-340-1331, www.interlinkelec.com). The company claims that the keyboard has a 50-foot, omnidirectional operating distance. The lap-shaped contours on the bottom of the keyboard make typing convenient and comfortable while you are seated and using the keyboard on

your lap. Another convenient feature is the touch pad that is built into the ample wrist rest. The VersaPoint has 79 standard and 10 function keys, and it weighs just 1.5 pounds when used with 4 AA batteries. —Michael N. Rusignuolo



INTERNET ACCESS SERVICES

Roam Away from Home

Do you often travel outside the range of your ISP's local dial-up numbers? Internet roaming services offer a less costly alternative to long-distance and international phone calls by letting you access your home Internet account via a local ISP or point of presence (POP) anywhere in the world.

If your ISP belongs to the Global Roaming Internet Connection (GRIC), you can try **Aimquest** (408-955-1920, www.aimquest.com). You have to use the GRIC Phone Book and Dialer—free from Aimquest's site—but you can continue to use your own e-mail client and browser as well as your regular account information. Individual ISPs set their own prices, which are generally around \$4 to \$6 per hour and 30 cents to \$1 per successful dial-in.

The iPass Alliance, a group of ISPs that have agreed to use iPass's NetService Software, also provides POPs worldwide. If your ISP is a member, you can use **iPass** (415-237-7300, www.ipass.com) as your roaming provider. The Dial Wizard client, free from the iPass Web site, offers an international phone book and entry via the access points listed. You can continue to use your own log-in and password information as well as your own browser, e-mail, and news-group software. As with Aimquest, charges vary from ISP to ISP, but they generally cost around \$2 to \$3 per month and anywhere from \$2.50 to \$15 per hour.

If your home ISP is not a member of the iPass Alliance, you can still take advantage of the group's POPs via the services of **Homegate** (310-533-3950, www.homegate.com). You can use all of your existing software and account information, but you'll also need a user

name and password. Prices range from \$5 to \$15 per month and from 8 to 50 cents per minute.

eGlobe joins the roaming scene with **eGlobe Connect** (888-345-6238, www.eglobe.com). You can access the Internet using any of its 250 POPs via local or toll-free numbers. You can also retrieve e-mail from any POP3 or IMAP4 account; calling up through a local number costs \$8 per hour, while using a toll-free number costs \$1.25 per minute.—*Nancy Sirapyan*



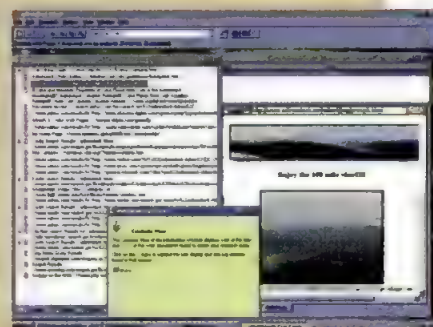
METASEARCHING

Net Detective

Like a good private eye, **WebSleuth**, from Prompt Software, can return copious amounts of information from the smallest of leads—in this case, just a keyword or two.

This \$49.95 metasearch tool (415-382-8840, www.promptsoftware.com), which can query an unlimited number of search engines simultaneously, uses proprietary technology to make your Web searches faster and more comprehensive. Before presenting its results, WebSleuth analyzes the returns from search engines based on content as well as context and disqualifies unrelated sites and broken links.

WebSleuth organizes its results into five views—Contents, Phrases, Words, Links, and Discards—tabulated alphabetically. You can refine your search by clicking on any of these generated terms. WebSleuth then returns all URLs that contain the term as well as the original keywords you entered to begin the search.—*Ellyn McCasland*



HAPPY HUNTING: Browse WebSleuth search results and view Web pages.

COMMUNICATIONS MANAGEMENT

Unified Messaging

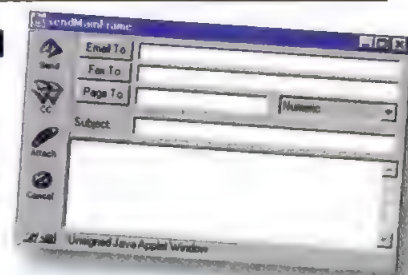
Given the many communications systems used in the office—e-mail, voice mail, pager, and fax—keeping workers accessible can be a real headache. Here are two new products designed to help you stay on top of staying connected.

To use Tornado Software Development's **Tornado Electronic Messaging System (TEMS)**, you need an Internet connection and a

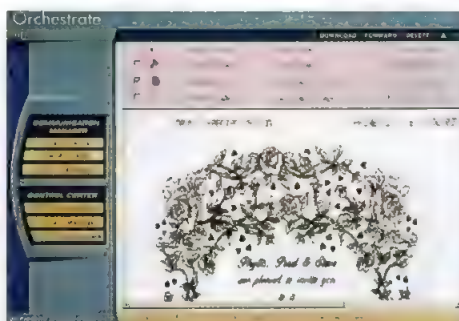
personal ID and password. You can handle e-mail, fax, voice-mail, and pager activity via the TEMS Java client applet. In addition to traditional fax and e-mail functions, you can send the same message to

multiple users in any format, retrieve mail from any POP2 or POP3 account, and send numeric or alphanumeric pages. A scheduler lets you designate when and how you get messages and whether TEMS should notify you of incoming e-mails and faxes. You can also listen to text-to-speech renditions of e-mails and faxes by phone.

Following a \$15 set-up fee, TEMS costs \$10 per month plus long-distance charges for outgoing faxes and pages (which will be routed through Tornado's Los Angeles



ONE-SHOT MESSAGING: Send e-mail, faxes, and pages from the TEMS Java Applet.



UNIVERSAL IN-BOX: Manage your messages by using Orchestrator's Communications Center.

Java-enabled browser (310-546-6319, www.tems.com). Simply log on at the TEMS site using a per-

office). Tornado hopes to set up local routing servers throughout the world by the end of the year.

Premiere Technologies' **Orchestrate** service (800-554-6079, www.orchestrate.com) lets you manage voicemail, e-mail, fax, pager, and cellular-phone functions via the Internet and a normal telephone without special software or hardware. You set up a public homepage with information on how you can be contacted—by e-mail, cell phone, pager, and so forth. You can then retrieve your messages by phone or PC, schedule conference calls, and reply to messages.

Currently, Premiere bases its fees on the level of services required; by next year, the company plans on offering rates starting at \$19.95 per month.—*Regina Kwon*

100 REASONS WHY

Word Processor Features	Corel® WordPerfect® 8	Microsoft® Word 97
Support for Intel MMX™ Technology	✓	no
Libraries		
Clipart	10,000+	3,000+
Photos	250	140+
Interface		
Shadow Cursor	✓	no
Tile documents vertically	✓	no
Reveal Codes	✓	no
Save workspace	✓	no
Search for any codes	✓	no
Application bar	✓	no
Context-sensitive property bars	42	13
Internet*		
Automatic natural language hyperlinks	✓	no
Corel Barista™ (for Java™ publishing)	✓	no
Java applets	✓	no
Formatting Tools		
QuickFonts™/font preview	✓	no
Spell check drop cap words	✓	no
Guidelines	✓	no
Font preview from drop-down list	✓	no
Styles can include text and graphics	✓	no
User-defined borders and fills	✓	no
Image rotation	✓	no
Parallel columns	✓	no
Captions on any side of image	✓	above and below
Make It Fit™ to expand documents	✓	no
Customizable Make It Fit options across multiple pages	6	none
Undo levels	300	100
Multiple character drop caps	50	1
Tables		
Row and column indicators	✓	no
Automatic data fill (QuickFill™)	✓	no
Format painter tables	✓	no
Automatic calculation	✓	no
Formulas function across tables	✓	no
Number of formulas	98	18
Long Documents		
Create new lists	✓	no
Expand/contract subdocuments individually	✓	no
Predefined document summary fields	51	27
Proofing Tools		
Combined Spell Checker/Thesaurus/Grammar	✓	no
Prompt-As-You-Go	✓	no
Document dictionaries and editable main dictionary	✓	no
Automatic sentence rewrite (PerfectSense™)	✓	no
SGML		
Import/export	✓	no
SGML editing and validation	✓	no
Document creation tools based on DTD	✓	no
Transitioning		
Backward compatibility	✓	no
Convert Corel WordPerfect for DOS macros	✓	no
Use existing Corel WordPerfect for Windows® macros	✓	no
Corel WordPerfect for DOS keyboards	✓	no
Convert Corel WordPerfect 6.x files	✓	import only

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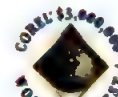
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PC Computing, July 1997



# Trends Networking

## PERSONAL MULTIPLEXERS

### Road Warriors Call Home

Most frequent travelers never leave home without their familiar crib sheets listing the dozens of phone numbers they need to keep in contact with the home office.

Data Race (800-329-7223, [www.datarace.com](http://www.datarace.com)) has come up with a solution that ties road warriors right to the corporate network with the **Be There! Personal Multiplexer System**. By dialing into the server portion of the product, you gain the complete functionality of your office phone, fax, and data networks over a single line. To reach a coworker, simply dial his or her phone extension as you would when you are in the office. Whatever your office-bound col-

leagues can do—conference calling, call forwarding, voice mail—you can do too, regardless of your location.

On the client side, the **Be There! Client** (pricing starts at \$479) acts as a V.34bis modem that connects to the corporate LAN and PBX. All calls made to and from the client go through the main office's PBX. Voice, data, and fax traffic are multiplexed over a single connection. The included CTI software provides users with a handy address book, call logs, and other



**TAKE TO THE ROAD:** *Be There!* helps you stay in touch with the office.

applications. The client adapters are available in an ISA bus for the telecommuter's desktop system or in PC card form for the road warrior's laptop system. Each version offers the very same functionality.

On the server side, Data Race features the **Be There! Personal Multiplexer Server** (pricing starts at

\$4,800), available in four configurations that support 4, 8, 16, or 24 simultaneous remote clients. The server works with IPX, TCP/IP, and PPP, and it can sit on either an Ethernet or Token-Ring network. Since the Multiplexer Server sits behind the network's firewall, it ensures that remote users are as well-protected as local users. Other security features include RAS link encryption, RADIUS support, limits on log-on attempts, inactivity time-out, and access restriction based on time of day.

—Robert Daly

## INTERNET FAXING

### A Reasonable Facsimile

According to a study by Gallup and Pitney Bowes, faxing represents 41 percent of the phone bills for US businesses. In addition, 74 percent of that faxing goes to international destinations.

Three services have cropped up to assist companies that require international faxing in volume.

UUNet Technologies (703-206-5600, [www.uunet.net](http://www.uunet.net)) has partnered with Ascend and OpenPort to provide **UUFax**, which allows you to send faxes over UUNet's considerable backbone for approximately ten cents a minute. Businesses with a UUNet connection (\$30 per month for individual dial-up service; business service starts at \$70) can subscribe to UUFax and send and receive faxes via e-mail, online faxing software, and standalone fax machines. UUFax will be available in the fourth quarter of 1997.

Already available are services from AimQuest Corp. (408-955-1920, [www.aimquest.com](http://www.aimquest.com)) and PSINet (703-904-4100, [www.psinet.net](http://www.psinet.net)). AimQuest's global faxing service draws on the connectivity

framework provided by the Global Reach Internet Connection (GRIC) alliance of Internet service providers and telcos.

AimQuest's charges vary depending on fax destinations, but the company claims they're 30 to

70 percent less than regular phone calls. There's no monthly service fee, but you have to purchase AimFax software, which starts at approximately \$20,000 for an eight-port configuration.

PSINet's **PSINet InternetPaper** follows the same model as UUFax by requiring you to have a subscription to the vendor's Internet service.

There's a \$100 set-up fee, and monthly service is available for \$50, \$100, or \$200 per month. As with UUFax, InternetPaper lets you send faxes from standalone fax machines or via a wide variety of faxing software. The service also has an HTML interface, so mobile users can fax from their Web browsers.

All three services monitor faxes during transmission and notify you upon receipt. For added security, UUNet and PSINet both use their own backbone infrastructure.—David R. Lambert

**AimQuest**

**PSINet**

**UUNET**

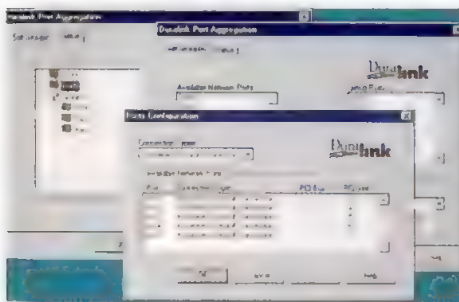
## HIGH-SPEED NETWORKING

### We Are Many, We Are One

What do you do when Fast Ethernet just isn't fast enough for your network? All the high-speed technologies out there—ATM, Fibre Channel, and Gigabit Ethernet—require a major capital investment

**Port Aggregation Software** and its Fast Ethernet PCI network interface cards. For example, using a \$375 **Adaptec Duralink Duo Card**, which features two autosensing, full-duplex 10/100 ports on a PCI bus, the Duralink Port Aggregation software can create a single virtual server-to-client connection of 200-Mbps throughput. 3.2-Gbps throughput is possible when aggregating 32 Fast Ethernet connections in groups of up to 12 ports per group.

Sun Microsystems is touting the bandwidth-trunking capabilities of its new **Sun Quad FastEthernet Network Interface Card**. Available in both a \$1,995 SBus and a \$1,795 PCI bus architecture, the card has four 10/100 Ethernet ports. Each port can be assigned individual addresses or, with the use of the \$995 trunking software package, linked together for a combined throughput of 400, 600, or 800 Mbps at full duplex.—RD



**THE FAST LANE:** Adaptec's new Duralink Port Aggregation Software.

in new hardware and, in some cases, cabling. Adaptec (408-945-8600, [www.adaptec.com](http://www.adaptec.com)) and Sun Microsystems (415-960-1300, [www.sun.com](http://www.sun.com)) have found ways to stretch your investment in Fast Ethernet by aggregating several Fast Ethernet connections into one virtual connection.

Adaptec's approach centers around the \$199 **Adaptec Duralink**



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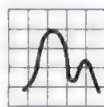
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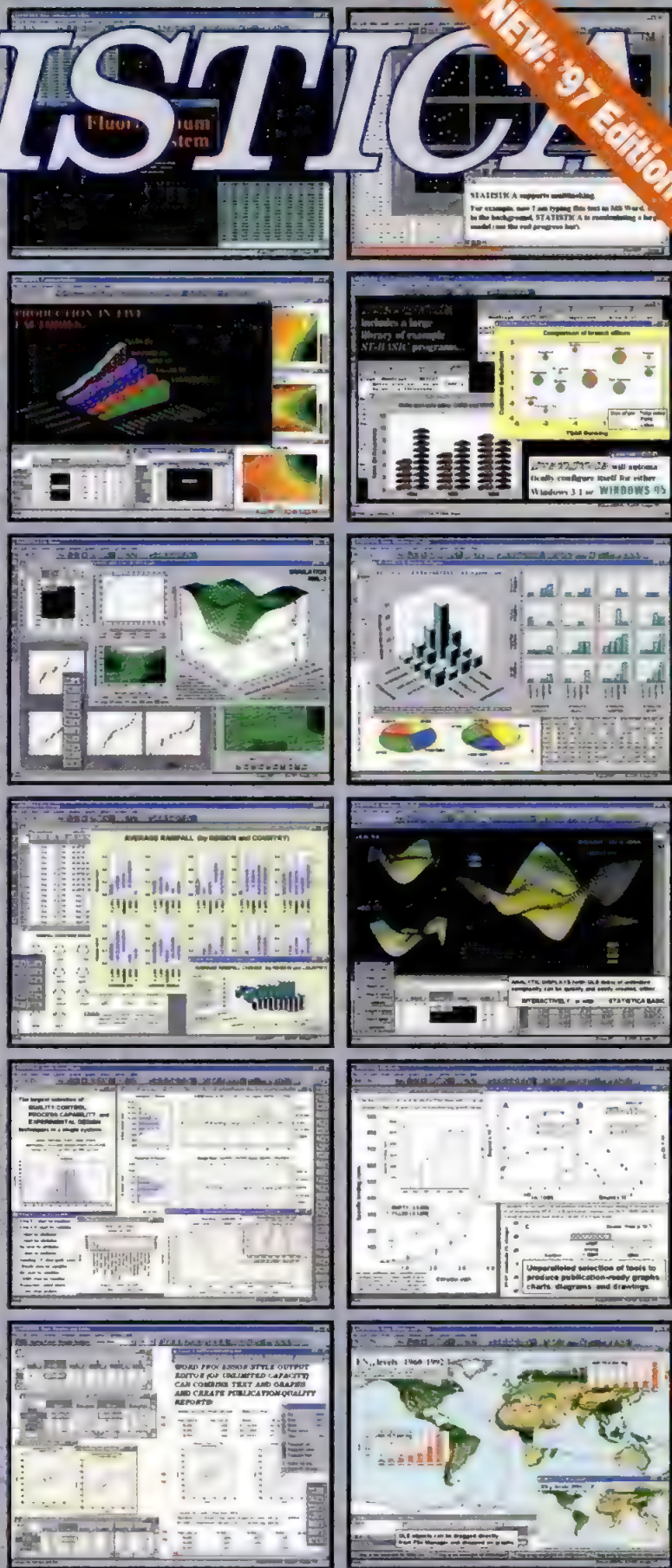
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- 10X CD-ROM
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TNB-5600

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TNB-5500



# First Looks



## Affordable Desktop Power

*Another challenger to Intel's Pentium Processor with MMX Technology arrives in the form of Cyrix's 6x86MX chip.—By Cade Metz and Melissa J. Perenson*

**C**ompeting with Intel requires much more than just a fast processor. Like AMD, Cyrix Corp. has developed a chip—the 6x86MX/PR233—that matches the performance of Intel's top-of-the-line consumer market CPU—the 233-MHz Pentium Processor with MMX Technology—when running mainstream business applications. Nevertheless, in spite of its fast performance, the Cyrix chip has yet to be adopted by a first-tier PC manufacturer. In a market where Intel accounts for almost 85 percent of all sales, leverage is as important as speed.

At the moment, the 6x86MX is being sold by a group of little-known—and largely direct sales—vendors. We review new PR233 machines from CyberMax Computer, PC Channel, Polywell Computer, Sys Technology, and USA Flex. These systems are worth considering, as they offer price-to-performance ratios that are equaled by few machines on the market.

### M2 ARCHITECTURE

The 6x86MX, formerly known as the M2, was announced last May. Its design is essentially an upgrade of the 6x86, a recently discontinued but admirable competitor to the classic Pentium. Built on a 0.35µ process, the new chip incorporates MMX instructions, 64K of L1 cache, enhanced floating-point and memory-management units, and a 2.8-volt core (for more on the 6x86MX design, see "The Best CPU for You").

Like the 6x86, the 6x86MX is defined not by clock speed but by performance rating (PR). Cyrix has unveiled three flavors of the chip: the PR166, the PR200, and the PR233. The PR166 runs at only 150 MHz, but its performance ostensibly rivals that of the MMX Pentium/166. The PR200 and the PR233 run at 166 MHz and 188 MHz, respectively, and both are designed to match the performance levels of the MMX Pentium/200 and MMX Pentium/233.

By July, mass quantities of the

PR166 and PR200 were available, but the PR233 was still sampling as we completed this story. You should be able to order the PR233 machines reviewed here by the beginning of September, but there may be a delay before you actually receive the product. Come the middle of October, production of the processor should be fully ramped up.

### PERFORMANCE RIVALS PENTIUM

Availability aside, the 6x86MX CPU is exceeding expectations. Testing done at PC Magazine Labs revealed the 6x86MX to be as fast as—and at times faster than—the MMX Pentium when running mainstream business software under Microsoft Windows 95. In identical systems with 32MB of memory, the 6x86MX/PR233 scored a 50 on our ZD Business Winstone tests, and the MMX Pentium/233 scored a 45. Intel's chip was more adept in MMX, 3-D, and floating-point testing.

In some respects, these afford-

## INSIDE



### POWER STATION:

Compaq's Professional Workstation 6000 comes equipped with a 266-MHz Pentium II processor. See page 56 for the review.

### SPEAK TO ME:

Dragon NaturallySpeaking bridges the gap between human speech and your PC. For the review, see page 64.



### DIGITAL DYNAMOS:

Minolta's Dimage V and the Sony Digital Mavica have striking similarities—and equally striking differences. See page 68 for the review.

### SEARCH PARTY:

The AltaVista Network and AltaVista Search Personal eXtension97 make your Web search a breeze. See page 73.

### EFFECTIVE:

Create slick composites with Adobe's After Effects 3.1. For the full review, see page 76.

### More Products Reviewed...

|                                                           |    |
|-----------------------------------------------------------|----|
| Peachtree Complete Accounting Plus Time and Billing ..... | 52 |
| Corel WordPerfect Suite 8 .....                           | 60 |
| Ultimate .....                                            | 76 |



# First Looks



## CyberMax BusinessMax C6 PR233 MMX

Street price: \$2,200

CyberMax Computer Inc., Allentown, PA; 888-486-1212, 610-770-1808; fax, 610-599-7576

[www.cybmax.com](http://www.cybmax.com)

Circle 412 on reader service card.

able systems can compete with Intel's Pentium II. Like Intel's 233-MHz Pentium with MMX Technology, Intel's sixth-generation design is certainly much better at handling MMX, 3-D, and floating-point functions; but its mainstream business performance is only slightly higher than that of the 6x86MX. During our chip comparison testing, the three flavors of Pentium II scored 51, 53, and 54 to the 6x86MX's 50 on the Business Winstone test.

Pentium/66 four years ago, the PR233 version of the 6x86MX makes use of a 75-MHz bus. Though this certainly increases throughput, no Intel chip set is designed to run at 75 MHz. You must use a Cyrix-specific chip set from such vendors as SiS, Ali, and Via (these chip sets also work with the MMX Pentium) or make an Intel chip set do what it wasn't designed to do.

The Intel 430TX, for instance, is the only Socket 7 chip

set that allows for 33-MBps hard disk transfer rates via the Ultra DMA protocol. If you have an Ultra DMA hard-disk and wish to take advantage of its 33-MBps capabilities, you must run the TX at 75 MHz rather than the 66 MHz it was designed to support. According to Intel, the TX chip set wasn't engineered to run at 75 MHz; running it at that speed for sustained durations can affect long-term system reliability. The SiS, Ali, and Via chip sets keep peripherals at 33 MHz, whereas an Intel chip set ratcheted up to 75 MHz takes peripherals up to 37.5 MHz, half the bus speed.

Of course, no Socket 7 chip set supports Accelerated Graphics Port (AGP), the graphics technology now being used by Pentium II machines (see "The Two Faces of 300 MHz"). AGP, which allows the graphics board to talk directly to the chip set at 66 MHz, is available only on Intel's Pentium II-specific 440LX chip set. Intel is keeping AGP off the Socket 7 platform in order to pro-

mote Slot 1, the architecture used by the Pentium II. Third-party vendors are working on adding Ultra DMA and AGP support to their chip sets, but product won't reach the market until at least the end of the year.

The five systems reviewed in this roundup are each equipped with a 6x86MX/PR233 processor, 32MB of memory (SDRAM in four cases, EDO in one), a hard disk with at least 3.8GB of storage space (IDE in four cases, SCSI in one), a graphics card with at least 4MB of memory, a CD-ROM drive capable of at least 16X speeds, a modem capable of at least 33.6-Kbps speeds, a 16-bit sound card, and a pair of speakers. All but the SCSI machine are priced below \$2,400, and two cost less than \$2,000.

## THE MERGER

Although Cyrix hasn't reached the top tier in the mainstream North American market with the 6x86MX chip, the path has been paved by the success of the company's MediaGX chip, which is being used by Compaq to drive its sub-\$1,000 systems. National Semiconductor, a global semiconductor manufacturer with an eye on the MediaGX platform, recently merged with Cyrix. National's primary reason for making the estimated \$550 million

## TECHNOLOGY LAGS

That said, the 6x86MX still lags behind the Pentium II when it comes to support for emerging technologies. Most of the machines in this roundup used an aging Baby AT motherboard, lacked a PS/2 keyboard connector (which means you'll need an adapter to connect a PS/2 keyboard to the antiquated large DIN connector), and don't support new Ultra DMA hard disks. Like the K6, the 6x86MX relies on Socket 7 and also in part on chip sets that are behind the curve in many respects.

Whereas the Pentiums and the K6 still depend on the 66-MHz bus that debuted with the

## SUMMARY OF FEATURES

### Cyrix 6x86MX/PR233 PCs

| Products listed in alphabetical order                                   | CyberMax BusinessMax C6 PR233 MMX | PC Channel CTX LCM233-32 | Polywell Poly C233Mx        | Sys Performance 233M2     | USA Flex UltraPerformer 233 |
|-------------------------------------------------------------------------|-----------------------------------|--------------------------|-----------------------------|---------------------------|-----------------------------|
| Price of tested configuration (32MB RAM, 512K L2 cache 17-inch monitor) | \$2,200 (street)                  | \$1,900 (street)         | \$2,000 (street)            | \$2,908 (direct)          | \$2,478 (direct)            |
| Memory type                                                             | SDRAM                             | EDO DRAM                 | SDRAM                       | SDRAM                     | SDRAM                       |
| Chip set                                                                | SiS 5571                          | Intel 430VX              | SiS 5571                    | Intel 430TX               | SiS 5571                    |
| Graphics adapter                                                        | Matrox Millennium II              | Matrox Mystique          | Diamond Stealth 3D 2000 Pro | Number Nine Revolution 3D | Matrox Millennium II        |
| Memory and type                                                         | 4MB WRAM                          | 4MB SGRAM                | 4MB EDO DRAM                | 8MB WRAM                  | 4MB WRAM                    |
| Hard disk                                                               | IBM DHEA-36480                    | Maxtor 84000A6           | Maxtor 87000A8              | Seagate ST34501W          | Quantum OM34320ST-A         |
| Capacity and interface                                                  | 6.1GB ATA-3                       | 3.8GB ATA-3              | 6.7GB ATA-4                 | 4.3GB Ultra Wide SCSI     | 4.2GB Ultra ATA             |
| CD-ROM drive vendor (speed)                                             | Toshiba (24X)                     | Tatung (16X)             | Toshiba (16X)               | TEAC (24X)                | Samsung (20X)               |
| Warranty (parts/labor)                                                  | 3 years/1 year                    | 1 year/1 year            | 2 years/5 years             | Varies/1 year             | 3 years/1 year              |
| On-site service (one year)                                              | Included                          | Included                 | Included                    | Included                  | \$49                        |



stock swap was to embrace MediaGX, enhance it, and use it to spearhead a sub-\$500 PC market.

National has already bought a second company, Mediamatics, whose MPEG encoder and decoder will likely be incorporated into Cyrix's already multifaceted chip. And although National seems uninterested in the 6x86MX, the company's presence should help the chip's development. When Cyrix shifts the 6x86MX to a 0.25μ manufacturing process at the beginning of next year, it will still have to use IBM's fab, but National's new 0.25μ fab in South Portland, Maine, should be ready within a few months. Having its own fab should speed Cyrix's development and manufacturing process.

The merger may also hasten the incorporation of the 6x86MX core into the all-in-one model of the MediaGX, which currently runs on Cyrix's 586 core. A MediaGX that competes with the MMX Pentium or the Pentium II will surely give Cyrix additional leverage in the market.

#### M2'S FUTURE

Development continues on the 6x86MX chip, which should reach a 225-MHz clock speed and a PR266 rating by the end of the year; a 255-MHz and

## Editors' Choice

### • CyberMax BusinessMax C6 PR233 MMX

*Despite the fact that the Cyrix 6x86MX/PR233 processor has yet to be adopted by a first-tier*



PC manufacturer, this MMX-enabled CPU makes it possible to buy a powerful PC for an incredible price. The BusinessMax C6 PR233 MMX, from CyberMax Computer, earns our Editors' Choice, because it offers the best balance of price, performance, and features. This system was consistently a top-notch performer on our benchmark tests.

A complete package priced at \$2,200, the BusinessMax comes loaded with 32MB of synchronous DRAM, 512K of L2 cache, an ample 6.1GB IBM hard disk, a Matrox Millenium II graphics board with 4MB of WRAM, and a K56Flex 56.6-Kbps modem. The strong multimedia offerings include an Ensoniq PCI 32-bit wavetable sound card, a speedy 24X Toshiba

CD-ROM drive, a microphone, and a pair of Altec Lansing ACS45 speakers with an ACS250 subwoofer. The system also bundles a 17-inch MAG monitor and Microsoft Office Small Business Edition. To round out the package, CyberMax provides a comprehensive three-year parts and one-year labor warranty that includes a year of on-site service.

Honorable mention goes to the Sys Performance 233M2, which was the other top performer on our benchmark tests. Priced at \$2,908, the system features 32MB of SDRAM, a Number Nine Revolution 3-D graphics card with 8MB of WRAM, a Teac 24X CD-ROM drive, a pair of speakers from MidiLand, a 17-inch KDS monitor, and a 33.6-Kbps modem. The system's major benefit is its super-fast, 10,000-rpm, 4.3GB Cheetah Ultra Wide SCSI hard disk from Seagate. If you're willing to trade off a smaller but faster hard disk and a variable warranty (parts are covered on an individual basis, depending upon coverage from the original component manufacturer) for an additional \$700, then this system may be right for you.

PR300 rating is forthcoming once the 0.25μ process is adopted. AMD and Intel are achieving higher clock speeds, because the K6 and the Pentium II dispatch a simpler set of decoded instructions to their execution units before the decoding stage.

Even if the 6x86MX is some-

how able to match the clock speed of the Pentium II, it has yet another disadvantage. Using an SEC cartridge that plugs into Slot 1, the Pentium II's L2 cache runs at half the processor's clock speed. In contrast, L2 caches on K6 and 6x86MX machines must run at system bus speed (66

MHz or 75 MHz); to compensate, these chips have larger L1 caches (the 6x86MX's L1 cache, at 64K, is four times larger than that of the 6x86).

What the 6x86MX truly needs, however, is a faster L2 cache. Cyrix is currently considering an on-board cache that would run at

## BENCHMARK TESTS

### Cyrix 6x86MX/PR233 PCs



The overall leader on our benchmark tests of Cyrix 6x86MX/PR233 PCs was the Sys Performance 233M2, from direct vendor Sys Technology. The major component behind this machine's number-one Winstone and Disk WinMark scores was its 10,000-rpm Seagate Cheetah Ultra Wide SCSI hard disk. This system also

turned in the best Graphics WinMark score, thanks mainly to its 8MB Number Nine Revolution 3-D graphics board.

Right on the heels of the Sys unit was our Editors' Choice, the CyberMax BusinessMax C6 PR233 MMX. Its Winstone score was a mere two points behind the Sys entry's score—probably an insignificant difference to an end user.

|                                   | <b>ZD Business<br/>Winstone 97</b><br>Score | <b>ZD Business<br/>Graphics<br/>WinMark 97</b><br>Score | <b>ZD Business Disk<br/>WinMark 97</b><br>Thousands of bytes/sec | <b>ZD CPUmark<sub>16</sub></b><br>Score | <b>ZD CPUmark<sub>32</sub></b><br>Score | <b>ZD CD-ROM<br/>WinMark</b><br>Thousands of bytes/sec |
|-----------------------------------|---------------------------------------------|---------------------------------------------------------|------------------------------------------------------------------|-----------------------------------------|-----------------------------------------|--------------------------------------------------------|
| CyberMax BusinessMax C6 PR233 MMX | <b>52</b>                                   | <b>111</b>                                              | <b>1,260</b>                                                     | <b>466</b>                              | <b>505</b>                              | <b>1,420</b>                                           |
| PC Channel CTX LCM233-32          | 47                                          | 87                                                      | 1,010                                                            | 488                                     | 480                                     | 976                                                    |
| Polywell Poly C233Mx              | 48                                          | 94                                                      | 1,040                                                            | N/A                                     | 501                                     | 1,380                                                  |
| Sys Performance 233M2             | <b>54</b>                                   | <b>123</b>                                              | <b>1,680</b>                                                     | <b>474</b>                              | <b>498</b>                              | <b>1,280</b>                                           |
| USA Flex UltraPerformer 233       | 47                                          | 85                                                      | 995                                                              | 470                                     | 479                                     | 1,170                                                  |
|                                   | BETTER ►                                    | BETTER ►                                                | BETTER ►                                                         | BETTER ►                                | BETTER ►                                | BETTER ►                                               |

N/A—Not applicable. The product could not perform this test.



# First Looks

## CTX LCM233-32

Street price: \$1,900

PC Channel Inc., City of Industry, CA; 818-839-9999; fax, 818-839-9998

[www.ctxcomputer.com](http://www.ctxcomputer.com)

Circle 411 on reader service card.

the CPU clock speed (like the Pentium Pro) or a card similar to the SEC that offers a half-speed L2 cache and plugs into Socket 7. Regardless, the bus speed of the PR300 will be raised to either 83 MHz or 100 MHz.

Looking forward, the 6x86MX will likely remain a value market processor. At the current time, 6x86MX machines are remarkably worthwhile for the price.

CyberMax Computer Inc.

## BusinessMax C6 PR233 MMX

CyberMax Computer's BusinessMax C6 PR233 MMX, our Editors' Choice in this roundup, packs a powerful punch. Although it's \$2,200 price tag is slightly higher than some of its competitors, the mini-tower system's performance was particularly strong across the board, often besting the other systems in this roundup.

As with the majority of the 6x86MX machines reviewed here, the BusinessMax features a Baby AT motherboard. Like the Polywell and USA Flex systems, the CyberMax uses the Cyrix-specific SiS 5571 chip set, which is designed to handle the 75-MHz bus by keeping PCI peripherals running at 33 MHz. The BusinessMax uses the same MTI motherboard as the Polywell unit.

Awkwardly situated toward the top of the motherboard (an area already crowded with cables to off-board serial and parallel ports) are the system's DIMM and SIMM slots. One 32MB SDRAM DIMM module was installed, leaving four SIMM slots and one DIMM slot open for expansion.

With a K56Flex 56.6-Kbps ISA modem, an Ensoniq PCI



32-bit wavetable audio card, and a PCI Matrox Millennium II graphics card with 4MB of WRAM installed, two ISA slots and one PCI are available for expansion. The system has four 5.25-inch drive bays; one of the bays is occupied by the Toshiba 24X (max) CD-ROM, which was predictably the top scorer on our CD-ROM WinMark test.

The sole accessible 3.5-inch bay is utilized by the floppy disk drive, although there is an available 3.5-inch internal drive bay. The available bay is located above the hard disk, so you'll have to maneuver the crowded interior of the chassis and remove the hard disk in order to make use of the bay.

All of the I/O ports at the rear of the machine are clearly labeled. Peripheral hardware includes a 17-inch MAG monitor, a pair of Altec Lansing ACS45 speakers with ACS250 subwoofer, and a microphone.

CyberMax is targeting the small-home-office and small-to-midsized corporate markets with this machine; the appeal of the BusinessMax is sweetened by the bundling of Microsoft Office Small Business Edition.

The BusinessMax comes with a three-year parts and one-year labor warranty that in-

cludes a year of on-site service. An outstanding Pentium/233-level performer for just over \$2,000, the CyberMax BusinessMax stands out from the crowd—*Melissa J. Perenson.*

PC Channel Inc.

## GTX LCM233-32

The CTX LCM233-32 system, from PC Channel, may not have been the speediest performer in this roundup, but its \$1,900 price is certainly attractive.

Like every other system reviewed here (with the exception of the Sys Technology machine), the LCM233-32 uses a Baby AT motherboard. Cables to off-board serial and parallel ports obstruct two PCI slots, leaving one ISA and one shared slot available for expansion. The system has an off-board PS/2 mouse port.

This system's motherboard uses an Intel 430VX "Triton" chip set, a technology that was not meant to handle Cyrix's 75-MHz bus. This chip set runs much faster than the 66 MHz it was designed to support, and all PCI peripherals operate at 37.5 MHz (33 MHz is typical).

With a Matrox Mystique graphics card (4MB of SGRAM) and a CD-ROM drive

that reaches a maximum speed of 16X, its Graphics WinMark and CD-ROM WinMark scores were slightly lower than the competition's scores. A 5,400-rpm Maxtor hard disk brought Winstone and Disk WinMark scores above those of the USA Flex system. This is also the only 6x86MX machine that made use of EDO DRAM; two SIMM slots as well as two DIMM slots are left open for expansion.

The system's mini-tower chassis is not particularly roomy: With two 3.5-inch external drives bays occupied by a floppy disk drive and the hard disk and one 5.25-inch external bay occupied by the CD-ROM, only two external 5.25-inch bays are open for expansion. The machine ships with a 17-inch CTX monitor, a Boca 33.6-Kbps modem, a 16-bit Sound Blaster-compatible sound card, and generic stereo speakers.

PC Channel sells through reseller and retail channels. The LCM233-32, backed by a one-year warranty and a year of on-site service, is not as adept as its competitors, but it is a remarkable buy.—*Cade Metz*

Polywell Computer Inc.

## Poly C233Mx

The \$2,000 Poly C233Mx, from Polywell Computer, is a bit more expensive than CTX's LCM233, but it is also slightly more adept. This system is a representative 6x86MX design. A mini-tower with a Baby AT motherboard and a Cyrix-specific SiS 5571 chip set, it exhibits average 6x86MX performance and sells for an average 6x86MX price. Polywell manages to differentiate the system from the competition with a modest SOHO software bundle.

The system's MTI motherboard (the same model used by the CyberMax BusinessMax) offers 32MB of SDRAM from a single DIMM while leaving a second DIMM and four SIMMs open for expansion. Yet these slots are difficult to





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PROCESSOR

# Like peas in a



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Need solutions for your growing network?

If you can dish it out, our systems can take it. Our ClientPro PCs and Vetix servers effortlessly get your network running – and keep it running.

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# pod.



Complement your server with our ClientPro desktops. We've designed them to be easy to set up, easy to upgrade and easy to network. That means you reduce potential downtime and lower your total cost of ownership. And if you have networking questions – your answers are just a phone call away. That's what our unwavering customer support is all about.

This powerful pair makes networking easy. And that's a pretty sweet dish.

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## The Micron Powerdigm<sup>™</sup> sets a sizzling pace.

The Powerdigm is our new workstation, turbo-powered by dual Pentium Pro processors. Believe it. This is the ultimate system for all your graphic design projects, engineering graphics, financial analyses, CAD and more!

Super-hot Powerdigm features include the capability to run multiple hard drives and two monitors at the same time. And your system is network ready, right out of the box. You also have the option of adding Diamond Fire GL video cards, giving you awesome (and affordable) 3D imaging. Call Micron today for information on the Powerdigm and our other extra-hot performing systems!

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## MICRON<sup>®</sup> MILLENNIA<sup>®</sup> Xru WITH FUSION 3D<sup>™</sup>

Intel 266MHz Pentium<sup>®</sup> II processor (features MMX<sup>™</sup> technology)  
64MB EDO RAM  
6.4GB EIDE hard drive  
19" Hitachi SuperScan CM751, .26dp (18" display)

### STANDARD FEATURES

512KB internal L2 cache, 2MB BIOS  
Diamond Stealth Pro DX, 3D video, MPEG, 4MB EDO RAM  
Monster 3D graphics card with 4MB memory  
3.5" floppy drive, 100MB Iomega Zip drive  
DVD-ROM drive, DVD software, E4 Cool DVD PCI decoder card:  
6 channel AC-3 to 2 channel out capability, SPDIF output  
(digital audio out)  
US Robotics Sportster 56K x2 internal data/fax modem  
Awe 64 PCI sound card  
Cambridge SoundWorks/MicroWorks-  
2 speaker satellite with subwoofer stereo system  
Tool-free minitower or desktop  
Microsoft<sup>®</sup> Intellimouse, 104-key keyboard  
Microsoft Windows<sup>®</sup> 95 and MS<sup>®</sup> Plus! CD  
Microsoft Office 97 SBE CDs  
Universal Serial Bus connections  
Fusion 3D game pak:  
Mech Warrior 2: Mercenaries 3Dfx version  
AH-64D Longbow, U.S. Navy Fighters '97  
Command & Conquer, Popular 3Dfx  
Racing Sim  
MS Sidewinder Pro joystick  
5-yr/3-yr Micron Power<sup>™</sup> limited warranty

**\$3,999**

Bus. lease \$336/mo.

## MICRON MILLENNIA Xru

Intel 266MHz Pentium II processor (features MMX)  
64MB EDO RAM  
6.4GB EIDE hard drive  
17" Micron 700FGx, .26dp (16.0" display)

### STANDARD FEATURES

512KB internal L2 cache, 2MB BIOS  
3.5" floppy drive  
100MB Iomega Zip drive  
24X EIDE variable speed CD-ROM drive  
32 voice wavetable stereo sound with speakers  
US Robotics Sportster 56K x2 internal data/fax modem  
PCI 64-bit 3D video, MPEG, 4MB EDO RAM  
Tool-free minitower or desktop  
Microsoft Intellimouse, 104-key keyboard  
Microsoft Windows 95 and MS Plus! CD  
Microsoft Office 97 SBE CDs  
Multimedia Xcitement Pak  
(comprised of MMX technology-based software)  
Universal Serial Bus connections  
5-year/3-year Micron Power  
limited warranty

**\$2,999**

Bus. lease \$302/mo.

## MICRON MILLENNIA Lte P166

Intel 166MHz Pentium processor with MMX  
16MB EDO RAM  
2.1GB EIDE hard drive  
15" Micron 500FGx, .28dp (13.7" display)

### STANDARD FEATURES

512KB pipeline burst cache, flash BIOS  
3.5" floppy drive  
16X EIDE variable speed CD-ROM drive  
16-bit stereo sound and speakers  
PCI 64-bit 3D video, MPEG, 4MB EDO RAM  
Tool-free minitower or desktop  
Microsoft Mouse, 104-key keyboard  
Microsoft Windows 95 and MS Plus! CD  
Microsoft Works CD  
Universal Serial Bus connections  
5-year/3-year Micron Power limited warranty

**\$1,499**

Bus. lease \$167/mo.

## MICRON MILLENNIA MME WITH FUSION 3D<sup>™</sup>

Intel 233MHz Pentium processor with MMX  
48MB SDRAM  
4GB EIDE hard drive  
17" Micron 700FGx, .26dp (16.0" display)

### STANDARD FEATURES

512KB pipeline burst cache, flash BIOS  
Diamond Stealth Pro DX, 3D video, MPEG, 4MB EDO RAM  
Monster 3D graphics card with 4MB memory  
3.5" floppy drive  
100MB Iomega Zip drive  
24X EIDE variable speed CD-ROM drive  
32 voice wavetable stereo sound  
Advent 370's - speaker/subwoofer system  
US Robotics Sportster 56K x2 internal data/fax modem  
Tool-free minitower or desktop  
Microsoft Intellimouse, 104-key keyboard  
Microsoft Windows 95 and MS Plus! CD  
Microsoft Office 97 SBE CDs  
Universal Serial Bus connections  
Fusion 3D game pak:  
Mech Warrior 2: Mercenaries 3Dfx version  
AH-64D Longbow, U.S. Navy Fighters '97  
Command & Conquer, Popular 3Dfx  
Racing Sim  
MS Sidewinder Pro joystick  
5-year/3-year Micron Power  
limited warranty

**\$2,799**

Bus. lease \$95/mo.

## MICRON MILLENNIA MME P200

Intel 200MHz Pentium processor with MMX  
48MB SDRAM  
4GB Ultra ATA hard drive  
17" Micron 700FGx, .26dp (16.0" display)

### STANDARD FEATURES

512KB pipeline burst cache, flash BIOS  
3.5" floppy drive  
100MB Iomega Zip drive  
24X EIDE variable speed CD-ROM drive  
32 voice wavetable stereo sound with speakers  
US Robotics Sportster 56K x2 internal data/fax modem  
PCI 64-bit 3D video, MPEG, 4MB EDO DRAM  
Tool-free minitower or desktop  
Microsoft Intellimouse, 104-key keyboard  
Microsoft Windows 95 and MS Plus! CD  
Microsoft Office 97 SBE CDs  
Multimedia Xcitement Pak  
(comprised of MMX technology-based software)  
Universal Serial Bus connections  
5-year/3-year Micron Power  
limited warranty

**\$2,299**

Bus. lease \$278/mo.

## MICRON POWERDIGM<sup>™</sup> Xli

Dual Intel 200MHz Pentium Pro processors  
64MB ECC EDO RAM  
4GB Ultra-Wide SCSI-3 hard drive  
19" Hitachi SuperScan CM751 (18" display) .26dp color monitor  
Number Nine Imagine 128 series II video card, 4MB VRAM

### STANDARD FEATURES

256KB internal L2 cache, flash BIOS  
3.5" floppy drive  
Plexstor 12/20 Plex variable speed SCSI CD-ROM drive  
Memory upgradable to 512MB ECC EDO RAM  
Supports multiple Ultra-Wide SCSI-3 hard drives  
PCI 32-bit Ultra Wide SCSI-3 controller  
Iomega Jaz SCSI drive with 1GB removable cartridge  
32 voice wavetable stereo sound with speakers  
3Com 3C905 Fast EtherLinkXL 10/100 PCI TPO network adapter  
Tool-free minitower  
Microsoft Intellimouse, 104-key keyboard  
Microsoft Windows NT<sup>™</sup> Workstation  
5-year/3 year Micron Power  
limited warranty

**\$4,899**

Bus. lease \$167/mo.

The CD-ROM drive will be removed upon the purchase of the DVD upgrade.

Maximum transmission speed of up to 50Mbps when downloading data and 33.0Mbps when uploading. However, actual performance is dependent upon numerous factors and





### MICRON VETIX Mxi

Intel 200MHz Pentium Pro processor  
128MB ECC EDO RAM  
Three 4GB Ultra-Wide SCSI-3 hard drives (12GB total)

#### STANDARD FEATURES

256KB integrated L2 cache  
Dual Pentium Pro ZIF sockets  
Memory upgradable to 1GB (8 DIMM slots)  
8 open expansion slots: 5 PCI, 2 ISA, 1 shared ISA/PCI  
Integrated Adaptec PCI Ultra-Wide SCSI-3 controller  
Integrated Intel EtherExpress Pro 100 controller  
Integrated SVGA graphics  
12x variable speed SCSI CD-ROM drive  
3.5" floppy drive  
5 internal, hot-swappable, hard drive array bays (upgradable to 10)  
3 external 5.25" media bays  
1 (one) 330 watt power supply standard  
(upgradable to 3 for added redundancy)  
Microsoft Mouse, 104-key keyboard  
Microsoft Windows NT Server 4.0 (10-user license)  
Intel LANDesk<sup>®</sup> Server Manager 2.52  
Integrated hardware instrumentation  
Dedicated server technical support, 7x24  
5-year/3-year Micron Power limited warranty  
1-year next-business-day on-site service<sup>1</sup>  
NOS Support (3 incident resolutions/  
1st year), 7x24

**\$7,999**

Bus. lease \$251/mo.

### MICRON VETIX<sup>™</sup> 2Mxi

Dual Intel 200MHz Pentium<sup>®</sup> Pro processors  
256MB ECC EDO RAM  
Five 4GB Ultra-Wide SCSI-3 hard drives (20GB total)

#### STANDARD FEATURES

512KB integrated L2 cache  
Mylex dual channel Ultra-Wide SCSI-3 RAID caching controller  
w/4MB ECC RAM  
Dual Pentium Pro ZIF sockets  
Memory upgradable to 1GB (8 DIMM slots)  
8 open expansion slots: 5 PCI, 2 ISA, 1 shared ISA/PCI  
Integrated Adaptec PCI Ultra-Wide SCSI-3 controller  
Integrated Intel EtherExpress<sup>™</sup> Pro 100 controller  
Integrated SVGA graphics  
12x variable speed SCSI CD-ROM drive, 3.5" floppy drive  
5 internal, hot-swappable hard drive array bays (upgradable to 10)  
3 external 5.25" media bays  
1 (one) 330 watt power supply standard  
(upgradable to 3 for added redundancy)  
Microsoft<sup>®</sup> Mouse, 104-key keyboard  
Microsoft Windows NT<sup>®</sup> Server 4.0 (10-user license)  
Intel LANDesk<sup>™</sup> Server Manager 2.52  
Integrated hardware instrumentation  
Dedicated server technical support, 7x24  
5-year/3-year Micron Power<sup>™</sup> limited warranty  
1-year next-business-day on-site service<sup>1</sup>  
NOS Support (3 incident  
resolutions/1st year), 7x24

**\$13,499**

Bus. lease \$424 mo.

### MICRON TRANSPORT Xpe

166MHz Mobile Intel Pentium processor with MMX  
32MB EDO RAM (80MB max)  
2.1 GB removable hard drive  
12.1" active matrix color display, 800x600

#### STANDARD FEATURES

Intel 430MX Mobile PCI chip set  
256KB L2 pipeline burst cache  
PCI graphics accelerator, 2MB VRAM  
EX modular CD-ROM drive  
Pick-a-Point dual pointing devices  
Sound Blaster 16-bit stereo sound  
Built-in stereo speakers and microphone  
Motorola Montana 33.6 fax/modem  
CardBus<sup>®</sup> and zoomed video-ready  
2 infrared ports, 1 front, 1 rear  
S-video and NTSC-video capability  
Built-in game port  
Management Pak, Executive Travel Pak  
2 modular expansion bays (hard drive, CD-ROM drive,  
3.5" floppy drive, lithium-ion battery)  
Custom nylon carrying case  
Microsoft Windows 95 and MS Plus! CD  
Microsoft Office 97 SBE CDs  
5-yr/3-yr Micron Power limited warranty

**\$3,599**

Bus. lease \$123/mo.

### MICRON TRANSPORT<sup>™</sup> Xke

166MHz Mobile Intel Pentium processor with MMX  
48MB EDO RAM  
3GB removable hard drive  
13.3" TFT XGA display

#### STANDARD FEATURES

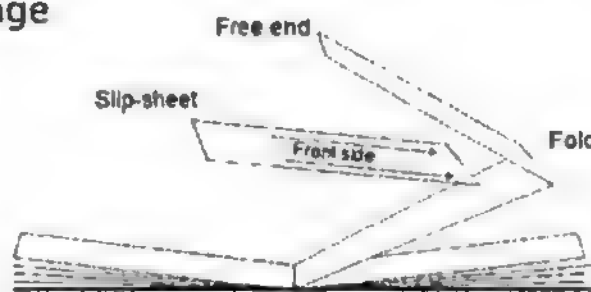
Intel 430TX Mobile PCI chip set  
512KB L2 pipeline burst cache  
PCI bus with 128-bit graphics accelerator, 2MB DRAM  
20X modular CD-ROM drive with AutoPlay<sup>™</sup>  
Pick-a-Point<sup>™</sup> dual pointing devices  
16-bit stereo sound  
(supports surround sound and wavetable)  
Built-in stereo speakers and microphone  
Motorola Integrated 33.6 fax/modem w/full telephony duplex phone  
CardBus<sup>®</sup> and zoomed video-ready  
2 infrared ports, 1 front, 1 rear  
S-video and NTSC-video capability, built-in game port  
Management Pak, Executive Travel Pak  
2 modular expansion bays (hard drive, CD-ROM drive,  
3.5" floppy drive, lithium-ion battery)  
Custom nylon carrying case  
Microsoft Windows 95 and MS<sup>®</sup> Plus! CD  
Microsoft Office 97 SBE CDs  
5-yr/3-yr Micron Power limited warranty

**\$5,399**

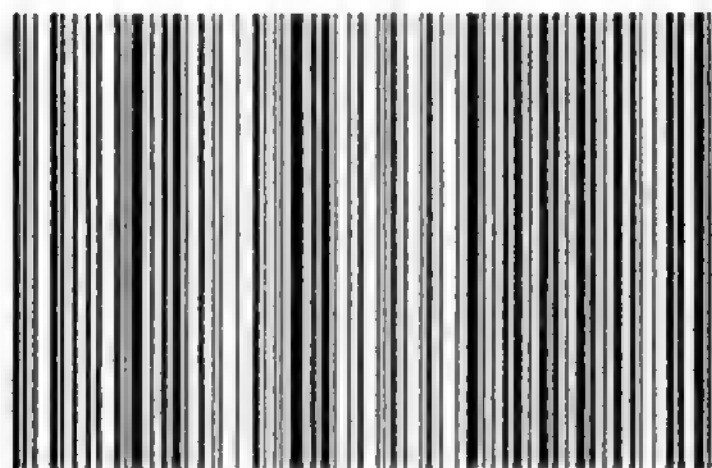
Bus. lease \$170 mo.



1. Open the foldout page
2. Insert this sheet with
  1. Front side touching the free page
  2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



### Foldout slip-sheet



GbsSlipSheet-001

Inverted Foldout slip-sheet

Folded edge of the page

1. Open the foldout page

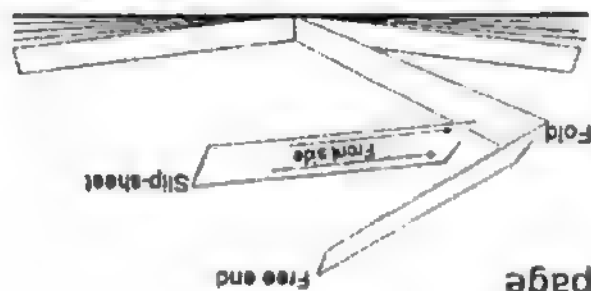
2. Insert this sheet with

1. Front side touching the free page

2. Arrow pointing to the fold

3. Slice the folded edge

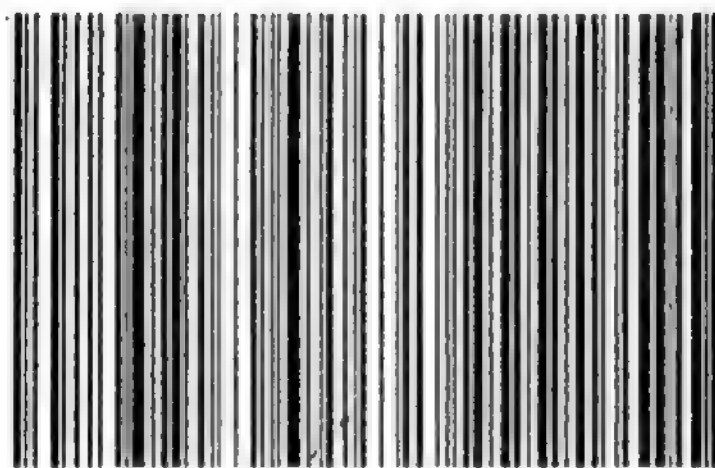
4. Close the page and slip-sheet





1. Follow instructions on the other side

Inverted Back



GbsSlipBack-0018

Back

1. Follow instructions on the other side

# Sweet deals.

## MICRON CLIENTPRO® XLu

Intel 233MHz Pentium II processor (features MMX™ technology)  
 32MB EDO RAM  
 2.1GB SMART EIDE hard drive  
 17" Micron 17FGx, .26dp (16.0" display)

### STANDARD FEATURES

512KB internal L2 secondary cache, DMI support  
 3.5" floppy drive  
 16X EIDE variable speed CD-ROM drive  
 3Com PCI 10/100 ethernet NIC  
 PCI 64-bit 3D video, MPEG, 4MB EDO RAM  
 Upgradable wavetable audio with speakers  
 Microsoft Intellimouse, 104-key keyboard  
 Microsoft Windows NT Workstation  
 Intel LANdesk® Client Manager  
 5-year/3-year Micron Power limited warranty

**\$2,549**

Bus. lease \$87/mo.

## MICRON VETIX Lxi

Intel 200MHz Pentium Pro processor  
 64MB ECC EDO RAM  
 4GB Ultra Wide SCSI-3 hard drive  
 15" Micron 15FGx, .28dp (13.7" display)

### STANDARD FEATURES

Dual Pentium Pro ZIF sockets  
 256KB integrated L2 cache  
 Memory upgradable to 1GB (8 DIMM slots)  
 8 open expansion slots: 5 PCI, 2 ISA, 1 shared ISA/PCI  
 Integrated Adaptec PCI Ultra-Wide SCSI-3 controller  
 Integrated Intel EtherExpress Pro 100 controller  
 Integrated SVGA graphics  
 12X SCSI-2 CD-ROM drive  
 3.5" floppy drive  
 9 drive bays: 6 internal 3.5", 3 external 5.25"  
 Microsoft Mouse, 104-key keyboard  
 Integrated hardware instrumentation  
 Dedicated server technical support, 7x24  
 5-year/3-year Micron Power limited warranty  
 1-year next-business-day on-site service\*  
 NOS Support (3 incident resolutions/1st year), 7x24

**\$5,099**

Bus. lease \$160/mo.

## MICRON CLIENTPRO MTe

Intel 166MHz Pentium processor with MMX  
 16MB EDO RAM  
 2.1GB SMART EIDE hard drive  
 15" Micron 15FGx, .28dp (13.7" display)

### STANDARD FEATURES

512KB pipeline burst cache, flash BIOS, DMI Support  
 3.5" floppy drive  
 3Com 3C905 network adapter  
 Integrated S3 VIRGE/DX graphics accelerator, 2MB EDO RAM  
 Integrated wavetable sound  
 Tool-free minitower or desktop  
 Microsoft Intellimouse, 104-key keyboard  
 Microsoft Windows 95  
 Intel LANdesk® Client Manager  
 5-year/3-year Micron Power limited warranty

**\$1,549**

Bus. lease \$53/mo.

## MICRON TRANSPORT VLx

133MHz Intel Pentium processor  
 16MB EDO RAM (40MB max.)  
 1.4GB hard drive  
 16X modular CD-ROM drive  
 Li-Ion battery  
 12.1" TFT SVGA, 800x600 display

### STANDARD FEATURES

Intel 430MX PCI chip set  
 256KB L2 pipeline burst cache  
 PCI bus with 128-bit graphics accelerator  
 MPEG compatible  
 Zoomed video-ready  
 Touchpad pointing device  
 16-bit stereo sound  
 Built-in stereo speakers and microphone  
 2-way infrared port  
 Modular floppy drive (flexible bay swappable with CD-ROM)  
 Microsoft Windows 95 and MS Plus!  
 5-year/1-year Micron limited warranty

**\$2,499**

Bus. lease \$85/mo.

\* On-site service for the Vetix server is provided by Digital Equipment Corporation and is optional.



# Appealing options.



## MULTIMEDIA OPTIONS

|                                                              |                   |
|--------------------------------------------------------------|-------------------|
| 32 voice wavetable stereo sound card                         | \$59 <sup>1</sup> |
| 32 voice wavetable stereo sound card with 2MB RAM            | \$99 <sup>1</sup> |
| Advent AV270 Powered Partners stereo speakers                | \$79              |
| Advent AV370 Powered Partners stereo speakers with subwoofer | \$199             |
| Microsoft <sup>®</sup> SideWinder 3D Pro joystick            | \$59              |
| Microsoft SideWinder gamepad                                 | \$39              |

## STORAGE/MEDIA OPTIONS

|                                                                               |                    |
|-------------------------------------------------------------------------------|--------------------|
| Adaptec 2940U Ultra SCSI Fast-20 controller                                   | \$100              |
| <i>upgrade from system with standard Ultra SCSI Fast-20 controller</i>        |                    |
| Plextor 12/20 Plex 3MB/sec SCSI internal CD-ROM drive                         | \$100 <sup>1</sup> |
| <i>upgrade from system with standard CIDE CD-ROM drive</i>                    |                    |
| Iomega Jaz SCSI drive with 1GB removable cartridge                            | \$299 <sup>1</sup> |
| Iomega ZIP IDE drive with 100MB removable cartridge                           | \$99               |
| Iomega 6-pack of 100MB Zip cartridges                                         | \$99               |
| Iomega Ditto 2000 (1/2GB)                                                     |                    |
| Travan tape backup drive with tape                                            | \$149              |
| Iomega Ditto 3200 (1.6/3.2GB)                                                 |                    |
| Travan tape backup drive with tape                                            | \$199              |
| Sony 4/8GB SCSI DDS-2                                                         |                    |
| tape backup drive with tape and software                                      | \$899 <sup>1</sup> |
| Cheyenne ARCserve with InocLAN (for servers)                                  | \$499              |
| Mylex dual channel Ultra-Wide SCSI-3 RAID caching controller with 4MB ECC RAM | \$899              |

## COMMUNICATION OPTIONS

|                                                               |                    |
|---------------------------------------------------------------|--------------------|
| 33.6 internal data/fax modem                                  | \$99               |
| 33.6 internal data/fax modem, speakerphone, <i>POWER MODE</i> | \$119 <sup>1</sup> |
| 33.6 external data/fax modem                                  | \$299              |
| 56Kbps technology modem <sup>2</sup>                          | \$99               |

## NETWORKING OPTIONS

|                                                     |       |
|-----------------------------------------------------|-------|
| 3Com 3C509B EtherLink III ISA combo network adapter | \$79  |
| 3Com 3C900 EtherLinkXL PCI combo network adapter    | \$99  |
| 3Com 3C905 Fast EtherLinkXL 10/100 PCI              |       |
| TPO network adapter                                 | \$99  |
| 3Com OfficeConnect Hub 8/TPC                        | \$149 |
| 3Com OfficeConnect Switch 140                       | \$969 |

## SOFTWARE OPTIONS

|                                                                                                                                                                                                                      |       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| EdVenture Pak: Sheila Rae the Brave, Putt-Putt Saves the Zoo, Reader Rabbit's Reading Development Library 1, Freddie Fish and the Case of the Missing Kelp Seeds, and the Thinkin' Things Collections 2 <sup>3</sup> | \$69  |
| Quicken Financial Pak: Quicken Deluxe, Quicken Financial Planner, Quicken Parents' Guide to Money, Quicken Family Lawyer <sup>4</sup>                                                                                | \$69  |
| CorelDRAW 7 <sup>5</sup> full retail version                                                                                                                                                                         | \$299 |
| Corel WebMaster Suite <sup>6</sup> full retail version                                                                                                                                                               | \$99  |
| Novell Intranetware 4.11, 5-user license, <i>(for Netix Lix-o only)</i>                                                                                                                                              | \$699 |

## HP PRINTERS

|                           |       |
|---------------------------|-------|
| HP DeskJet 692c printer   | \$319 |
| HP DeskJet 870Cxi printer | \$419 |
| HP LaserJet 6Lxi printer  | \$429 |
| HP LaserJet 6P printer    | \$799 |

## DISPL./VIDEO OPTIONS

|                                                                 |                    |
|-----------------------------------------------------------------|--------------------|
| 17" Hitachi SuperScan CM630 (15.9" display) .26dp color monitor | \$150 <sup>1</sup> |
| 21" Hitachi SuperScan CM801 (20.9" display) .26dp color monitor | \$650 <sup>1</sup> |
| Number Nine Imagine 128 series II video card, 4MB VRAM          | \$299 <sup>1</sup> |
| Number Nine Imagine 128 series II video card, 8MB VRAM          | \$549 <sup>1</sup> |

## TRANSPORT OPTIONS

|                                                                                                                                                                                                                                                                                                                         |       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| MicronDock <sup>™</sup> multimedia port replicator: ethernet 10BT LAN adapter, SCSI-2 port, S-video and NTSC-video output, built-in stereo speakers, infrared port, headphone, microphone, line-in jacks, parallel, serial, VGA and 2 PS/2 ports (with warm dock and built-in game port - available on XPE models only) | \$299 |
| Micron <sup>™</sup> Executive <sup>™</sup> desktop package: matching black 17" monitor (16.0" display), mouse, mousepad and keyboard (can be used with or without MicronDock)                                                                                                                                           | \$699 |
| Motorola Montana 33.6 fax/modem supports regular telephone connections, cellular phones and two-way paging devices                                                                                                                                                                                                      | \$259 |

## SCANNER OPTIONS

|                                |       |
|--------------------------------|-------|
| HP Scanjet 5s sheetfed scanner | \$269 |
| HP Scanjet 5p flatbed scanner  | \$399 |
| HP Scanjet 4c flatbed scanner  | \$799 |

## DESKTOP EXTENDED SERVICE OPTIONS

|                                                                  |      |
|------------------------------------------------------------------|------|
| Optional 1st year on-site service <sup>1</sup> coverage included |      |
| 2nd year on-site service <sup>1</sup> coverage                   | \$79 |
| 2nd and 3rd year on-site service <sup>1</sup> coverage           | \$99 |

Other service options may be available, ask your system consultant

## SERVER EXTENDED SERVICE OPTIONS

|                                                                                                               |       |
|---------------------------------------------------------------------------------------------------------------|-------|
| 2nd and 3rd year next-business-day <sup>1</sup> on-site service coverage <sup>2</sup>                         | \$99  |
| 4-Hour response <sup>3</sup> on-site service coverage <sup>2</sup> (8am-5pm, M-F), 3 years total              | \$798 |
| 4-Hour response <sup>3</sup> on-site service coverage <sup>2</sup> (24-hours, 7 days per week), 3 years total | \$998 |

Other service options may be available, ask your system consultant

## NOTEBOOK EXTENDED SERVICE OPTIONS *(N/A only)*

|                                                                                       |       |
|---------------------------------------------------------------------------------------|-------|
| 2nd and 3rd year parts and labor <sup>1</sup> ; 3-business-day turnaround for 3 years | \$269 |
| 2nd and 3rd year parts and labor <sup>1</sup> ; 7-business-day turnaround for 3 years | \$209 |

## OTHER OPTIONS

|                                                                    |       |
|--------------------------------------------------------------------|-------|
| APC Pure77 surge suppressor                                        | \$39  |
| APC Pure77 surge suppressor                                        | \$59  |
| APC Smart-UPS 700 with PowerChute plus software                    | \$389 |
| APC Smart-UPS 1000 with PowerChute plus software                   | \$529 |
| Microsoft Natural Keyboard <i>(upgrade from standard keyboard)</i> | \$49  |

<sup>1</sup> Upgrade from systems with standard 16-bit stereo sound card

<sup>2</sup> Requires SCSI host adapter

<sup>3</sup> Requires sound card

<sup>4</sup> Upgrade from system with standard Micron 17" 700Hz (16" display) color monitor

<sup>5</sup> Upgrade from systems with standard 64-bit 4MB video card

<sup>6</sup> 1st year on-site service is available in the United States and in limited areas in Canada from third-party service provider per customer's agreement with provider

<sup>7</sup> 2nd year and 3rd year offerings are available in the United States only

<sup>8</sup> Extended warranties, if purchased after system shipment may have a higher cost.

<sup>9</sup> Services will be scheduled, whenever possible, for the next business day after parts are received by the customer

<sup>10</sup> Available in certain locations, ask your system consultant for details.

Some options and accessories available with system purchase only

<sup>1</sup> Available only on desktop and notebook systems with Microsoft Windows 95.

<sup>2</sup> Maximum transmission speed of up to 56Kbps when downloading data and 33.6Kbps when uploading.

However, actual performance is dependent upon numerous factors and observed transfer rates may be less than the maximum potentials.

## MICRON POWER WARRANTY

5-year limited warranty on microprocessor and main memory  
3-year limited parts-only system warranty (1 year for Transport 16.0)  
1, 2 or 3-year optional on-site service agreement for Micron desktop and server systems  
30 days of free Micron-supplied software support for Micron desktop systems; 3 optional network operating system incident resolutions included for Micron server systems  
30-day money-back policy  
24-hour technical support

The warranty is subject to and qualified by Micron's standard limited warranties and terms and conditions of sale. Terms and conditions of sale may vary for specific configurations. Copies of the limited warranties may be obtained on our Web site or by calling Micron.



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CONFIGURED FOR YOUR LIFE



# First Looks



access: Cables to off-board serial and parallel ports crowd the upper area of the chassis.

With a 33.6-Kbps ISA modem, a Crystal ISA sound card, and a Diamond Stealth 3D 2000 Pro PCI graphics card (with 4MB of EDO DRAM) installed, two ISA slots and two PCI are available for expansion. This system's mini-tower chassis has no available 3.5-inch drive bays (one is occupied by the floppy disk drive and the other is taken by a 6.7GB, 5,200-rpm Maxtor IDE hard disk), but it does offer two open 5.25-inch bays. A third 5.25-inch bay is occupied by a 16X CD-ROM drive, which produced this roundup's second highest CD-ROM WinMark score. On all other tests, the Poly's scores were strictly middle of the road.

All of the I/O ports are conveniently labeled in the rear of the machine. Peripheral hardware includes a 17-inch Sampo monitor, QuickShot stereo speakers, and a microphone. A software bundle features Microsoft Encarta, Microsoft Works, and Microsoft Money.

Polywell, which does 60 percent of its business through the direct channel, markets the Poly

toward home-office users and supports it with a one-year on-site warranty and 24-hour, 7-day-a-week technical assistance. The Poly is yet another affordable 6x86MX machine; it does not use all the latest in hardware technology, but it does provide great performance for under \$2,000.—CM

*Sys Technology Inc.*

## Sys Performance 233M2

Priced at \$2,908, the Sys Performance 233M2, from Sys Technology, is \$750 to \$1,000 more expensive than the other four machines reviewed here, but it is the performance leader. Both its higher price and its performance edge are attributable to its 10,000-rpm Seagate Ultra Wide SCSI hard disk. All other tested machines used less expensive IDE interface drives.

This is also the only machine that doesn't resort to the Baby AT motherboard form factor. Its ASUS motherboard, encased by

### Sys Performance 233M2

Direct price: \$2,908

Sys Technology Inc., Cypress, CA; 800-613-9963, 714-821-3900; fax, 714-821-9592

[www.systechology.com](http://www.systechology.com)

Circle 415 on reader service card.

### Poly C233Mx

Street price: \$2,000

Polywell Computer Inc., South San Francisco, CA; 800-999-1278, 415-583-7222; fax, 415-583-1974

[www.polywell.com](http://www.polywell.com)

Circle 414 on reader service card.

a full-tower chassis, offers both an integrated PS/2 keyboard port and an integrated PS/2 mouse port. Though this is certainly expected in today's PC market, it is unique within the context of this review. Thus the interior of the Sys Performance chassis is orderly and spacious: its three open bus slots (one ISA slot, one PCI slot, and one shared slot) and its four open drive bays (two 5.25-inch externals, one 3.5-inch external, and one 3.5-inch internal) are all easily accessible.

The Sys Performance system uses 512K of L2 cache and 32MB of memory. All 32MB of SDRAM are contained in a single DIMM slot, leaving one DIMM and four SIMMs unused. This system is the only one in our roundup with 8MB of graphics memory (WRAM integrated into an admirable Number Nine Revolution 3-D card) and one of only two with a maximum CD-ROM speed of 24X.

The true trump card here is the unit's 4.3GB Cheetah hard disk. Performance was un-

matched on our Winstone, Disk WinMark, Graphics WinMark, and CD-ROM WinMark tests. The system also ships with a 17-inch KDS monitor, two speakers from MidiLand, and a 33.6-Kbps ISA modem.

A direct-channel vendor, Sys Technology provides a one-year warranty that includes on-site service and round-the-clock technical support. The company recommends the Sys Performance 233M2 to users wanting an inexpensive alternative to Intel-based machines.

Although the Sys Performance system's price is not as affordable as other 6x86MX offerings, the extra dollars may be justified by the quality of the hardware and the overall performance.—CM

*USA Flex Inc.*

## Flex UltraPerformer 233

Another of the original 6x86MX launch partners (along with PC Channel and CyberMax), USA Flex has upgraded its Cyrix line to the PR233 level with the \$2,478 Flex UltraPerformer 233. This mini-tower system ships with an adept Matrox Millennium II graphics card, but its hard disk was a low scorer relative to the immediate competition.

Though the UltraPerformer's







Christian Murphy was non-verbal. He lived with a wall between himself and the world.

**1** THIS IS CHRISTIAN.  
He can see, hear, feel, touch,  
but he cannot speak. He was born  
with autistic tendencies that cut  
him off from the world around him.







**2** A TEACHER DISCOVERED that Christian would respond to images from his life. She put visual cues to the story of his new puppy on a special keyboard.



NEC MultiSync Monitor  
E and A Series

**3** THE MONITOR BECAME HIS VOICE. With it he makes class reports and conversation. With it, Christian, 11, has been in the regular Osterville, MA public school since first grade.



→ **Until he found this window.**



**4** WITH THE PICTURES, HE MADE SENTENCES. With the sentences, he made friends. Christian's monitor is the window between his non-verbal world and the speaking world of his friends. Through it, he teaches them many things.

**T**HE MONITORS THAT ARE BEST FOR CHRISTIAN'S NEEDS can also speak to yours. Introducing the NEC MultiSync® Enterprise and Advanced Series, the monitors for people looking for superior, lifelike images. And the monitors for people who want the kind of flexibility that super high resolutions and refresh rates ensure.

OSM™ (On-Screen Manager) controls make image adjustments easy. Plus, select Enterprise monitors feature CROMACLEAR™ CRT, for unparalleled focus, contrast and intense color saturation. And, of course, the industry-leading NEC warranty includes 3 years parts, labor and CRT.

For more information on the new performance-driven MultiSync Enterprise and value-oriented Advanced Series call 1-800-NEC-INFO or visit [www.nec.com](http://www.nec.com).



MULTISYNC® MONITORS

|       | Max Res            | Bandwidth | CRT Type   | Pitch       |
|-------|--------------------|-----------|------------|-------------|
| A500  | 1280 x 1024 @ 60Hz | 112MHz    | Dot Trio   | 0.28mm dot  |
| A700  | 1280 x 1024 @ 65Hz | 119MHz    | Dot Trio   | 0.28mm dot  |
| E500  | 1280 x 1024 @ 65Hz | 119MHz    | CROMACLEAR | 0.25mm mask |
| E700  | 1600 x 1200 @ 65Hz | 177MHz    | CROMACLEAR | 0.25mm mask |
| E1100 | 1600 x 1200 @ 65Hz | 177MHz    | Dot Trio   | 0.28mm dot  |

  
Expect more. Experience more.

**NEC**





# First Looks

## Flex UltraPerformer 233.

Direct price: \$2,478.

USA Flex Inc., Bloomington, IL; 800-872-3539,  
630-893-0345; fax, 630-351-7204

[www.usaflex.com](http://www.usaflex.com)

Circle 413 on reader service card

SiS chip set (the same one that's used in the Polywell and CyberMax models) does not support the new 33-Mbps disk transfer rate, the system's 4.1GB Quantum Ultra ATA hard disk does. Having to run at roughly 16 MBps, the drive turned in this roundup's lowest Disk WinMark score and contributed to a slightly lower Winstone score as well. With a Matrox Millennium II graphics card (4MB of VRAM) and a 20X CD-ROM drive, Graphics WinMark and CD-ROM WinMark scores, respectively, were average.

The system's Baby AT moth-



erboard integrates two DIMM slots (used in our test system by two 16MB SDRAM modules) and four SIMM slots. The board also has three ISA slots, three PCI slots, and one shared slot. The tested machine's PCI graphics board and ISA Creative Labs

audio card are standard, but its ISA modem is optional. The base system sells for \$2,399, while 33.6-Kbps and 56-Kbps modems sell for \$79 and \$99, respectively.

The UltraPerformer came to us with a Microsoft PS/2 mouse, but the system didn't have a PS/2

mouse port. We had to track down a serial mouse in order to run the machine. USA Flex claims that the shipping system will add a PS/2 mouse port. All rear ports are clearly labeled.

The system chassis provides two open 5.25-inch drive bays and two open 3.5-inch bays, one internal and one external. Other peripherals include a pair of Altec Lansing ACS40 stereo speakers, a Micro Innovations joystick, and a 17-inch MAG monitor.

USA Flex offers several pre-loaded applications: Corel Office 7, Compton's Home Library, Typing Teacher, Infopedia 2, Adobe Acrobat, and several entertainment titles. These are appealing, but they may not be worth the price difference between the UltraPerformer and other machines in this roundup.—CM □

## ACCOUNTING SOFTWARE

# Tracking Your Time and Money

*A robust small-business accounting program just got better.—By Kathy Yakal*

Until now, the best way to integrate time and billing records with entry-level accounting software has been to link your bookkeeping program to Timeslips, from Timeslips Corp. By incorporating time- and expense-related services, Peachtree Software's Peachtree Complete Accounting Plus Time and Billing 4.0 (\$249 list) provides enough transaction-processing and reporting capabilities to accommodate businesses of roughly 25 employees.

Peachtree Complete Accounting features general ledger, accounts payable/receivable, inventory, and payroll functionality in an interface that helps make bookkeeping understandable. The new version adds time and billing capability to two primary areas of the product: inventory setup and reports.

Since time and expense charges are considered inventory items, you can build your data-

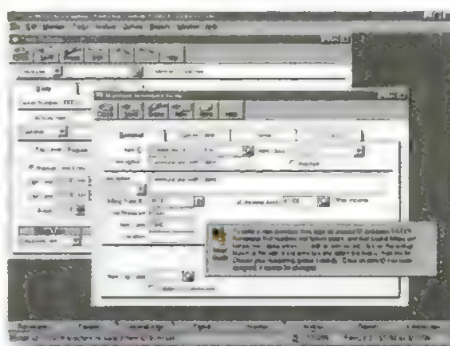
base of records either from the Maintain/Inventory menu or on the fly. Item-record screens contain a generous number of fields for describing each activity or expense, including five rate levels and user-definable units of measure, up to 25 tax types, five custom fields, and a customer-history screen.

Peachtree Complete provides two forms for entering time and expense tickets; these forms are located on the Tasks menu. As you incur expenses, you can document them, bill them to a specific customer, or bill them as an administrative expense.

From other drop-down lists you can select elements of the charge, including the item or service, the duration of billable time, and the cost. You can also mark the billing status as billable, non-

billable, no charge, or hold.

This information flows to the invoicing function. When you click Apply Tickets/Reimbursable Expenses on an in-



**DEFINING TERMS:** You can define new time and expense items on the fly.

voice, a window opens listing outstanding time and expense charges. Click the Use box next to any customers that you want to bill and they'll be automatically applied. The same goes for Payroll. As you're selecting em-

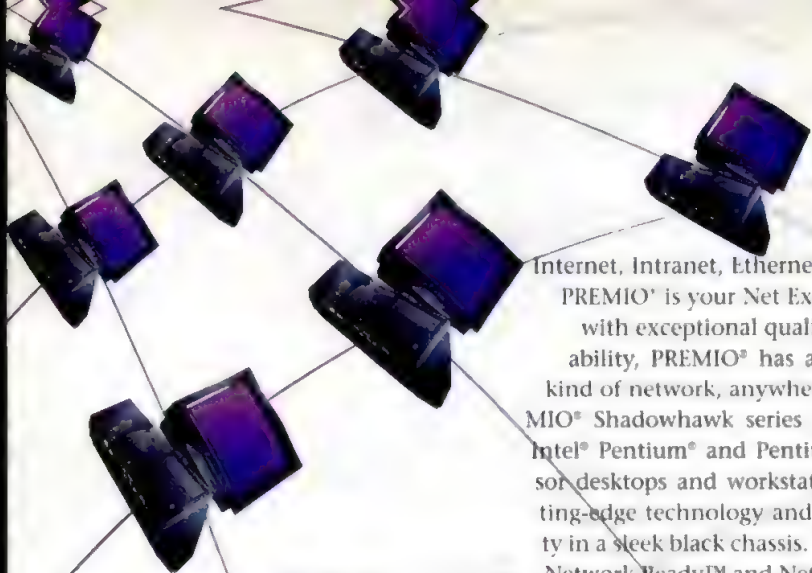
ployees for payment, you can specify that time tickets be included up to a selectable date.

Nine new time- and expense-related reports appear in the product's report generator (including Aged Tickets and Tickets Used). Like other Peachtree reports, they're quite customizable, and you can drill down from line items to underlying transactions.

Peachtree Complete Accounting Plus Time & Billing offers more time- and expense-related transaction detail and reporting than its nearest competitor, QuickBooks Pro. It's also more economical (though less thorough) than Timeslips. So if you're hunting for a powerhouse bookkeeper, it should serve your needs.

**Peachtree Complete Accounting Plus Time and Billing 4.0.** List price: \$249. Requires: 8MB RAM, 26 to 40MB disk space, Microsoft Windows 3.1 or later. Peachtree Software Inc., Norcross, GA; 800-228-0068; [www.peachtree.com](http://www.peachtree.com). Circle 410 on reader service card.





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Frankly put, we're here to overturn the workstation establishment. (Remember what we did for desktops, servers and portables?) As representative proof, glance at these specs. You'll see that the Dell WorkStation 400 is available with dual 300MHz Pentium® II processors, the fastest Intel® processors for enhanced CAD and 3D graphic performance. And at these prices, they're declarations of war. Care to be liberated? Visit us on the Web or give us a call.



Mini-tower chassis anticipated to ship 9/97 (although customers can order now) ★ Prices and specifications valid in the U.S. only and subject to change without notice. †For a complete copy of our limited warranties, please write Dell USA L.P., One Dell Way, Round Rock, TX 78682 Attn: Warranties. Δ On-site service provided by third-party providers and may not be available in certain remote areas. 3Com and EtherLink are registered trademarks of 3Com Corporation. ©Copyright 1997, Standard Performance Evaluation Corporation. Information value correct as of print date. Intel, the Intel Inside logo and Pentium are registered trademarks of Intel Corporation. Windows and Windows NT are registered trademarks of Microsoft Corp. ©1997 Dell Computer Corp. All rights reserved.

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- 3 Year Limited Warranty\* with 1 Year NBD On-site<sup>a</sup> Service
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- 4GB Ultra/Wide SCSI-3 Hard Drive (7200RPM)
- APPIAN Jeronimo J2 Graphics Card
- 24X Max/12X Min EIDE CD-ROM Drive
- Sound Blaster Compatible Audio
- Integrated 3Com 10/100Mb Fast EtherLink XL
- Factory Installed Windows NT 4.0 with 1 Year Telephone Support
- Two 1000LS Monitors (15.9" v.i.s.)
- 3.5" Floppy Drive
- 3 Year Limited Warranty with 1 Year NBD On-site Service
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**3D GRAPHICS WORKSTATION****DELL WORKSTATION 400M**  
300MHz PENTIUM II PROCESSOR  
(Dual Processor Capable)

- 128MB ECC EDO Memory
- 2GB Ultra/Wide SCSI-3 Hard Drive (7200RPM)
- ELSA Gloria-L/MX Graphics Card
- 24X Max/12X Min EIDE CD-ROM Drive
- Sound Blaster Compatible Audio
- Integrated 3Com 10/100Mb Fast EtherLink XL
- Factory Installed Windows NT 4.0 with 1 Year Telephone Support
- 20HS Trinitron® Monitor (19.0" v.i.s.)
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Order Code: 900005

**\$6579**

Order Code: 900004



20" Monitor (19.0" v.i.s.) option is depicted.

Dell's expertise in industry-standard technology gives the Dell WorkStation 400 a price/performance edge over selected models from significant competitors, as shown below. These tables reflect a 3D-graphics-oriented benchmark modeling an environment similar to mechanical CAD.

| Viewperf CDRS Benchmark <sup>1</sup> Test<br>Workstations - Relative Price Performance <sup>1</sup> |                                                           |       |
|-----------------------------------------------------------------------------------------------------|-----------------------------------------------------------|-------|
| Dell                                                                                                | WorkStation 400 266MHz w/ELSA Gloria-M Glint MX           | \$195 |
| IBM <sup>a</sup>                                                                                    | IntelliStation M Pro Model 26U INGR w/Intense 3D Pro 1000 | \$297 |
| SGI                                                                                                 | O2 R5000/180MHz SCO2                                      | \$538 |
| Sun Ultra                                                                                           | Ultra 1 Creator3D Model 170E w/Creator3D                  | \$448 |
| Digital                                                                                             | Personal Workstation 266i w/AccelGraphics AccelPro 2500TX | \$624 |
| SGI                                                                                                 | Octane 1x175MHz R10000 SI w/Tram                          | \$922 |

<sup>1</sup>Price per composite score. Lower number indicates greater price value. For more in-depth information, refer to [www.specbench.org/gpc/gpc.cdrs.summary.html](http://www.specbench.org/gpc/gpc.cdrs.summary.html)

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# First Looks

## PENTIUM II WORKSTATIONS

### Designing Innovation

*Compaq's Professional Workstation 6000 showcases a highly serviceable design—at a price.—By Cade Metz*

**C**ompaq Computer Corp. has bolstered its workstation lineup with Professional Workstations based on the Pentium II processor. At the heart of this product line is the Professional Workstation 6000, which is aimed at CAD modeling and financial-analysis applications. This machine's design is unquestionably one of the most innovative available today.

The only drawback to this machine is price: A system outfitted with a single 266-MHz Pentium II CPU, 128MB RAM, a 4.3GB Ultra Wide SCSI hard disk, and a Diamond Fire GL 4000 3-D graphics accelerator costs \$8,580 (street). This is about \$2,500 more than 300-MHz Pentium II workstations from Dell or Micron, reviewed in this issue's cover story ("The Two Faces of Pentium II").

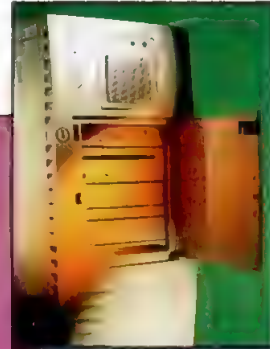
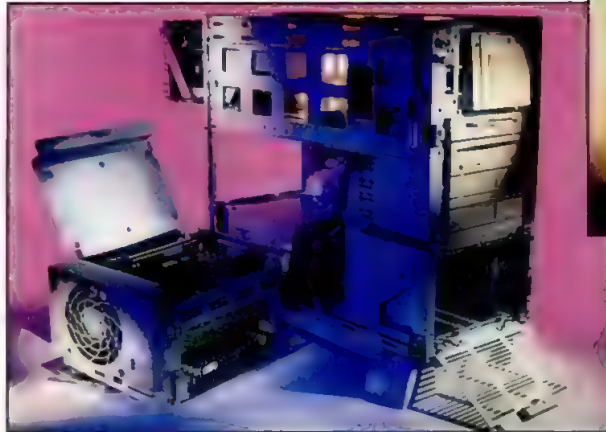
#### UNDER THE HOOD

The 6000's strapping mini-tower sits on a low, four-footed stand. Its front panel carries an integrated speaker and a small plastic door that swings open to reveal four 5.25-inch drive bays. Two of the bays were occupied in the system that we tested, one with a floppy disk drive and the other with a 16X CD-ROM drive.

The Professional Workstation 6000's innovations become clear when you open it up. With a turn of the key, the front panel comes off and bares three thumbscrews. Once these screws are undone, a top panel and a side panel come off as well. Internally, the system is divided into six compartments.

Three front compartments

run down the front of the 6000's chassis. The uppermost is merely a space that holds the integrated speaker, a fan, and the unit's power switch. The two other front compartments are



**INSIDE AND OUT:** The Compaq Professional Workstation 6000's accessible components (left) and convenient front panel (right).

for drive expansion: One holds the aforementioned 5.25-inch bays, and the other holds six 3.5-inch bays. After undoing a fourth thumbscrew, you can remove a metal door and gain access to the six smaller bays. On our test system, one bay was occupied by a 4.3GB, 7,200-rpm Seagate Barracuda Ultra Wide SCSI hard disk.

The salient innovations reside in the two other rear compartments: a removable expansion slot cage (with two PCI slots and

four shared slots) and a removable processor cage. Each holds a board that plugs into a backplane in the middle of the system. When you pull two rigid levers in the rear of the machine, these cages pop right out.

The expansion board also houses an integrated SCSI adapter, two USB ports, an external SCSI port, plus a

age. But its score on the ZD High-End Graphics WinMark 97 test (with its 2-D board installed) was significantly lower, most likely due to the discrepancy in processor speeds.

Results were mixed on our AutoCAD and Pro/Engineer tests. The 6000 compared fa-

vorably with Dell's WorkStation and IBM's IntelliStation on Pro/E, but it took twice as long to complete our AutoCAD test. We can safely assume that performance should only improve with a 300-MHz Pentium II CPU installed.

The Professional Workstation 6000's design reflects careful optimization. The only "gotcha" is the price, which is significantly higher

than the competition. It's up to you to decide whether Compaq's extras are worth its premium price.

**Compaq Professional Workstation 6000.** Street price: With a 266-MHz Pentium II processor, 128MB of EDO RAM, 4.3GB Ultra Wide SCSI hard disk, Diamond Fire GL 4000 graphics card, \$8,580. Compaq Computer Corp., Houston, TX; 800-388-8542, 512-338-4400; [www.compaq.com](http://www.compaq.com). Circle 409 on reader service card.

## PERFORMANCE TESTS

### Compaq Professional Workstation 6000



We put the Compaq Professional Workstation 6000 (Pentium II/266) to the test with two different graphics cards: the Diamond Fire GL 4000, a 3-D board with 16MB of RAM, and the Matrox Millennium II, a 2-D board with 8MB

of RAM. With the 2-D card the unit scored better on our High-End Winstone 97 and High-End Graphics WinMark 97 tests.

For performance comparison with 300-MHz Pentium II workstations, see this issue's cover story, "The Two Faces of 300 MHz."

|                                    | ZD High-End Winstone 97<br>Score ▲ | ZD High-End Graphics WinMark 97<br>Score ▲ | ZD High-End Disk WinMark 97<br>Thousands of bytes/sec ▲ | AutoCAD<br>Min sec ▼ | Pro/Engineer<br>Min sec ▼ |
|------------------------------------|------------------------------------|--------------------------------------------|---------------------------------------------------------|----------------------|---------------------------|
| Compaq 6000—16MB 3-D graphics card | 24                                 | 24                                         | 3.260                                                   | 4:33                 | 3:20                      |
| Compaq 6000—8MB 2-D graphics card  | 32                                 | 31                                         | 3.070                                                   | N/A                  | N/A                       |

N/A—Not applicable. We did not run this test with the 2-D graphics card.



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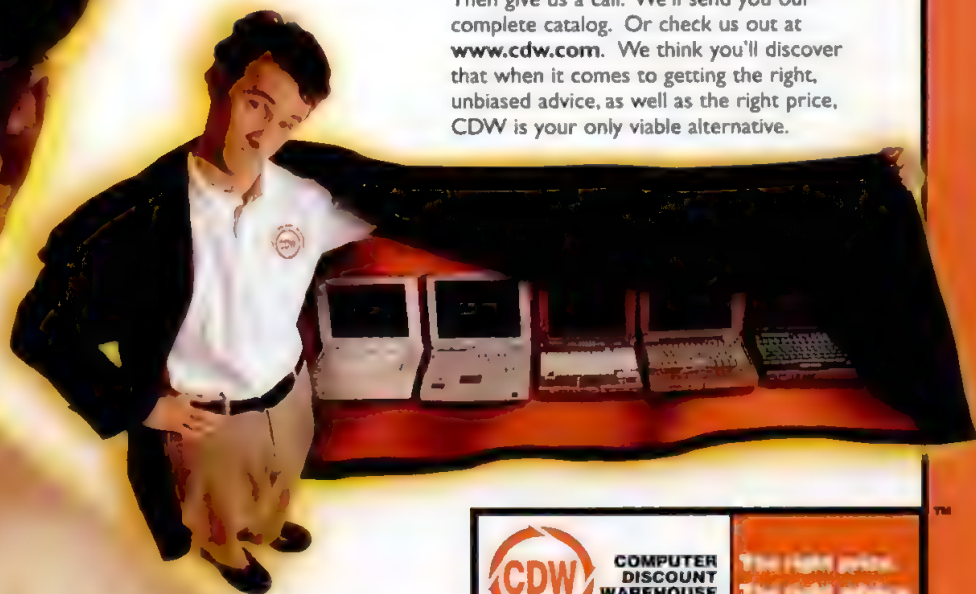
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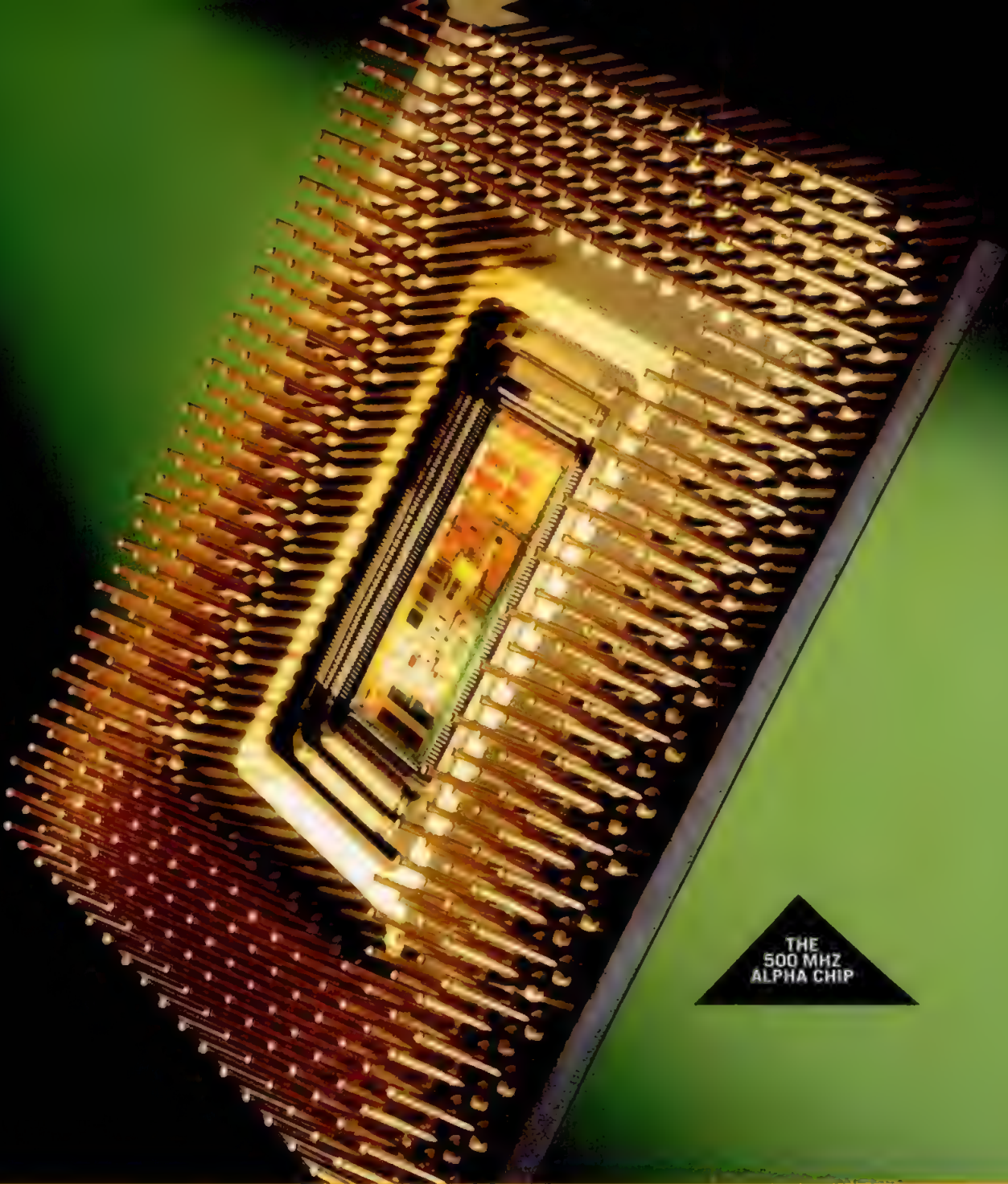
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# First Looks

## SUITES

### Closer to Perfection?

New features highlight Corel's WordPerfect Suite 8.

—By Edward Mendelson and Craig Stinson

Corel's office application suite is back—a sleek, tightly integrated upgrade that offers quick access to remote Internet files and startling improvements in speed and efficiency. Corel WordPerfect Suite 8 (\$395 list; upgrade, \$179), which is compatible with Microsoft Windows 95 and Windows NT 4.0, includes Corel WordPerfect 8, Corel Quattro Pro 8, and Corel Presentations 8, all controlled from the Desktop Applications Director toolbar and automated by PerfectScript.

WordPerfect Suite 8 also includes Inso's QuickView Plus, Netscape Navigator 3.0, the Envoy electronic-document viewer, the Barista printer driver (which creates Java applets that display full-formatted documents for viewing with a Web browser), Corel's PhotoHouse graphics package, and a cornucopia of clip art and fonts.

A special coupon in the box entitles you to CorelCentral PIM and an e-mail program. Fixes will also be available for first-release bugs and incomplete features (such as a text-indexer that is not fully integrated into the File/Open dialog). A professional version of the suite, due out later this year, will add a new version of the Paradox database.

Unlike Microsoft Office 97, which caused widespread problems by introducing new file formats, the new Corel suite uses the same formats as before. But the menu structure has been simplified, and a new context-sensitive Property Bar, located beneath the main toolbar, instantly switches between text, graphics, and data-management tools as you move the cursor.

The Application Bar, at the foot of the document window, combines familiar status bar functions with the functions of the Windows 95 taskbar. Buttons that appear on the Application Bar correspond to the documents open in the current application, so you can switch effortlessly between documents or use the buttons as drag-and-drop targets. Toolbars have a "flat" look like those in Microsoft Office 97, and dialogs are smaller, more manageable, and more informative than in previous versions.

Corel one-ups Microsoft's wizards with its PerfectExperts, automated templates that offer extensive options for creating complex files. When you use a

system, confusingly named PerfectExpert, doesn't answer questions as well as Microsoft's Office Assistant. But, on the other hand, it doesn't waste screen space with animated icons.

Notably, all programs in the suite open with greater speed than their considerably more sluggish predecessors. Gone is the tangle of secondary applications for printing and macro automation. A brand new SDK is now provided for professional developers, but unlike Microsoft's VisualBasic for Applications, Corel's PerfectScript doesn't require programming experience if you want to create or modify macros.

File/Open and Save dialogs access the Internet directly. If Microsoft Internet Explorer is installed on your system, a small preview window displays remote files before you open them. All suite applications write to HTML.

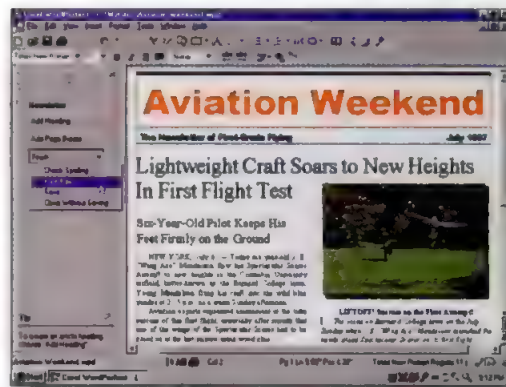
An awkwardly implemented versioning feature saves compressed copies of different states of your files and compares them using standard redlining and strikeout markings.

#### WORDPERFECT 8

With Version 8, WordPerfect finally puts an easy-to-use interface on its unparalleled range of features. Instead of cluttering the screen, advanced features are compactly displayed on the context-sensitive Property Bar and specialized toolbars for cross-references, tables of contents, and other functions.

Bullets, numbering, and outlining are now accessed from a customizable gallery-style dialog

that replaces the nightmarishly complex tools used in earlier versions. Like Microsoft Word, WordPerfect can automatically insert bullets and numbering or indent paragraphs without making you go to the menu. Automation features include on-



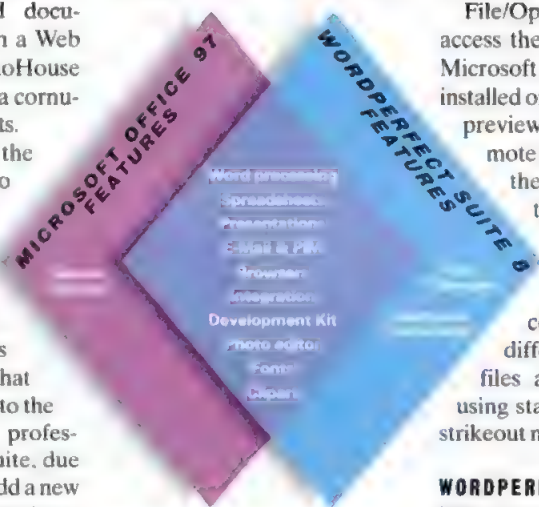
**EXPERTISE:** The PerfectExpert toolbar, left, lets you perform tasks in any sequence.

the-fly spelling and grammar corrections, the optional creation of live hyperlinks when you type Web addresses, and typographic refinements such as en-dashes and em-dashes.

WordPerfect lacks Word's sometimes overeager tendency of creating a headline when you type a one-line paragraph, but it has a more powerful make-it-fit feature that alters text in order to squeeze it onto a specified number of pages. The "shadow cursor," introduced in Version 7, shows you where text will be inserted if you click on the mouse.

A new equation editor based on Design Science's MathType replaces the command-driven editor. Both editors are available, but equations created with one editor can't be modified by the other.

HTML-creation tools include easy-to-add form fields and buttons. An integrated SGML module—the only one that's available for any current word-processor—makes WordPerfect the first choice for many manufacturing and military sites. A new drawing layer lets you place graphic objects on top of the text. But WordPerfect doesn't



**FACE-OFF:** Microsoft Office 97 and WordPerfect Suite 8 include many parallel components.

PerfectExpert, a panel appears on the screen's left with buttons that lead to dialogs in which you select document elements or insert boilerplate text. You can set options in a PerfectExpert template at any time and change them if you don't like the results.

Corel's natural-language help



offer text that flows from one text box to another. Tables support a hundred functions; table cells can be joined and split with a mouse-click, and cell text can also be rotated in 90 degree increments.

Automated templates are easy to create with simple dialogs, and the suite-wide address book is used for all merge and envelope features. WordPerfect's continued use of its established file format eliminates compatibility problems and provides Reveal Codes for exact control over every format detail. Unfortunately, it still lacks Microsoft Word's ability to display and edit different parts of the same file in separate windows. But where Word gets divided awkwardly between easy-to-use and programmer-only features, WordPerfect still makes all of its massive power available to everyone.

## QUATTRO PRO

Quattro Pro 8's editable Page View might be its most welcome new feature. As you build a spreadsheet model, Page View lets you see exactly where everything's going to line up on paper. Dotted lines reveal margins and header/footer spaces; you can adjust these spacing parameters by dragging and editing without leaving the worksheet. Another appealing novelty is Quick Cell, which lets you drag a cell to the application bar below your worksheet. As you work anywhere in the current notebook, the value of that cell remains visible on the application bar.

An on-the-fly Cell Reference Checker is designed to flag inappropriate relative references in formulas. Say you begin building an amortization schedule by referencing a group of cells that specify principal, interest, and term of loan. If you make those

The screenshot shows a Quattro Pro 8 window with a spreadsheet. The spreadsheet has columns for Principal, Interest, and Balance. A dialog box titled "Cell Reference Checker" is open, displaying a message: "The formula is using an empty cell." The dialog has buttons for "OK", "Cancel", "Details...", and "Help".

**ERROR TRAP:** Quattro Pro's new Cell Reference Checker flags references to empty cells.

references relative, replication of the schedule's initial formulas will soon generate references to blank cells. The new Cell Reference Checker will alert you to the problem and then offer to fix it for you.

Quattro Pro 8 also introduces a Cross Tabs command, which provides an attractive interface for generating simple reports. You can't rearrange columns and rows in the resulting tables, and Corel's Data Modeling Desktop application, which creates transposable crosstabs, is no match for Excel's PivotTable facility. Nevertheless, Cross Tabs is a welcome addition.

Quattro Pro has a QuickFilter command now (much like Excel's Auto Filter). It uses simple drop-down lists to help you focus on database rows that satisfy simple or complex criteria. Corel's implementation adds one useful idea: the ability to filter for blank or nonblank values. Quattro Pro can now outline, providing mouse controls that manage the level of detail shown in a complex model. The program does a good job of outlining worksheets, either automatically or manually.

The new Quattro also simplifies text display by letting you join cells and format characters individually. Toolbar buttons provide single-click superscripts and subscripts, and a drop-down

list takes the pain out of entering commercial symbols and accented characters. On the Internet front, however, Quattro Pro's HTML export still ignores charts (and it fails to tell you so), but you can use Barista technology to take care of this omission via Java.

With more than 400 functions, Quattro Pro retains its claim to having the largest assortment of computational esoterica. Plus, its handling of dates is more "21st-Century aware" than that of its competitors.

## PRESENTATIONS

Presentations 8 introduces support for MMX and DirectDraw technology. It also offers the ability to implant movies (.AVI, MPEG, or .MOV) into slide shows without relying on OLE. This new video support gives you greater control over the appearance and positioning of your fa-

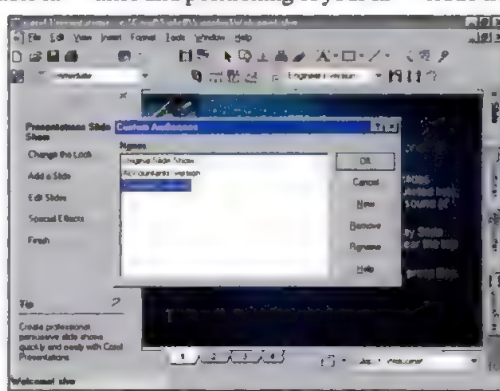
shared components and better integration with the suite's other core applications. Your slide shows can now be saved as Internet presentations thanks to Barista. The suite's inclusion of an equation editor enables slides to build equations. Slides can also make use of arty text via WordPerfect's TextArt feature. Improved integration with Quattro Pro simplifies the incorporation of spreadsheets into slides, and the new Corel Versions facility lets you save all iterations of an ever-evolving show.

## FIRST-RELEASE BLUES

The first release of WordPerfect Suite 8 is marred by minor problems and omissions (Corel promises to take care of these with a free upgrade that should arrive on its Web site by the time you read this). In the first release, if you choose a custom installation rather than a preset installation option, some features may not be usable. Some PerfectExpert templates include help buttons that trigger

an error message saying no help is available. In addition, some new features are inadequately described in the help text.

Long-term Microsoft Office users may not want to make the switch to Corel WordPerfect Suite 8, but for experienced WordPerfect and Quattro Pro users, this upgrade is essential. It combines



**ALTERNATIVES:** Presentations' Custom Audiences feature makes it easy to create alternative versions of a show.

vorite movie clips.

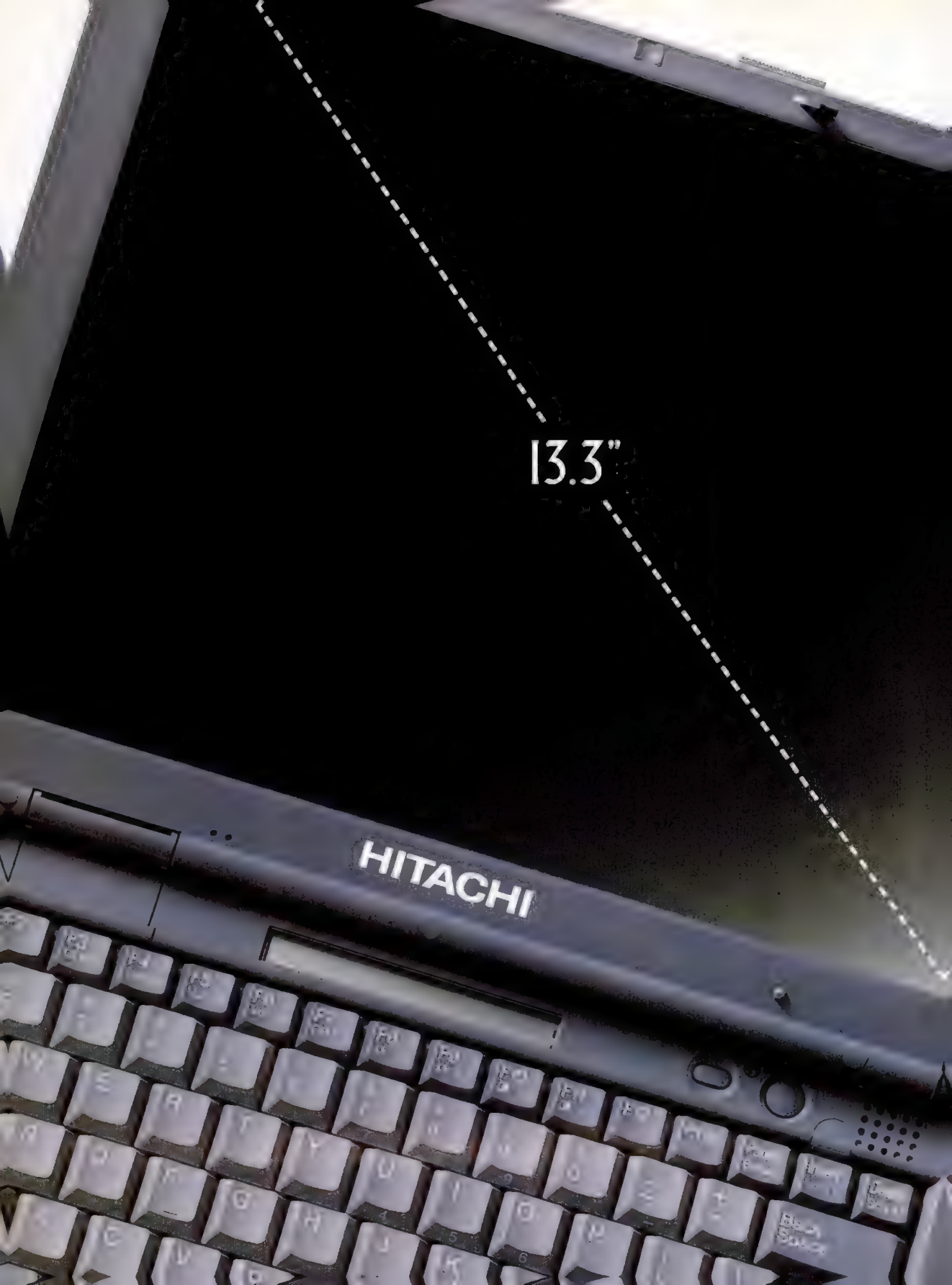
Presentations 8 also helps you set up alternative versions of a slide show for multiple audiences. For example, if you want to omit financial details for the engineering group and technical grit for the bean counters, just tell Presentations which slides to omit in each variant.

Other improvements to Presentations come primarily from

power with improvements in reliability, simplicity, and speed.

**Corel WordPerfect Suite 8.** List price: \$395 (upgrade and competitive upgrade, \$179). Requires: Microsoft Windows 95 or Windows NT 4.0 or higher, 16MB RAM, 50 to 120MB hard-disk space. Corel Corp., Ottawa, Ontario; 800-772-6735; 613-728-3733; [www.corel.com](http://www.corel.com). Circle 401 on reader service card.





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# First Looks

## VOICE RECOGNITION

### Natural Dictation

*Voice recognition reaches new heights with Dragon NaturallySpeaking. —By David Haskin*

Eventually, we'll use speech recognition to communicate with our computers as effortlessly as we do with our close friends. Those days aren't here yet, but Dragon NaturallySpeaking, Personal Edition 1.0, from Dragon Systems, is a step in that direction.

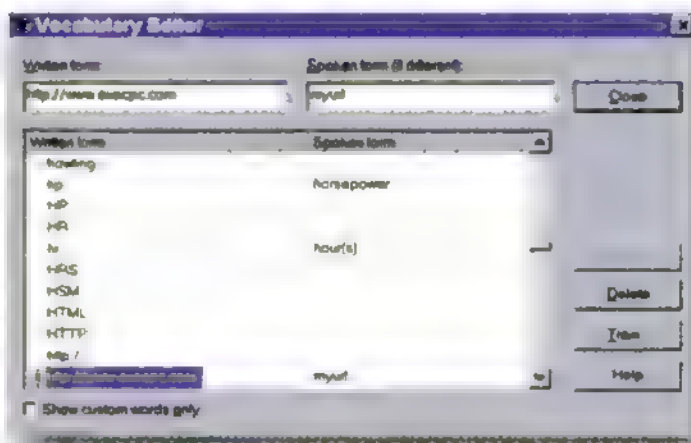
In contrast to earlier speech-dictation products, NaturallySpeaking (\$200 street) enables you to dictate text by talking in a normal tone of voice. Before you can start dictating, though, you will spend about an hour installing and training the software to recognize your speech patterns. NaturallySpeaking's main dictionary has acoustic information on 30,000 words; training teaches the program to recognize those words when you speak them. The main part of the training requires about 30 minutes of dictation.

NaturallySpeaking next requires about 10 minutes to compile a file that is specific to your voice. This way, you are able to dictate in a natural voice at approximately 100 words per minute with a roughly 90 percent accuracy rate.

As you correct dictation errors, NaturallySpeaking becomes more accurate. To take care of mistakes, you highlight an incorrect word or phrase and say, "Correct that." A dialog box then appears listing alternatives. You can use the keyboard or voice commands to select a listed alternative, or you can spell it out if necessary. NaturallySpeaking adds the correction to your voice file.

The Vocabulary Builder lets you add words to the dictionary that are specific to your needs,

such as technical or legal terms, by examining documents on your hard disk and identifying words contained there that it doesn't recognize. You can then add new entries to the dictio-



**BUILDING WORDS:** NaturallySpeaking's vocabulary builder adds words to the dictionary.

nary by saying them aloud.

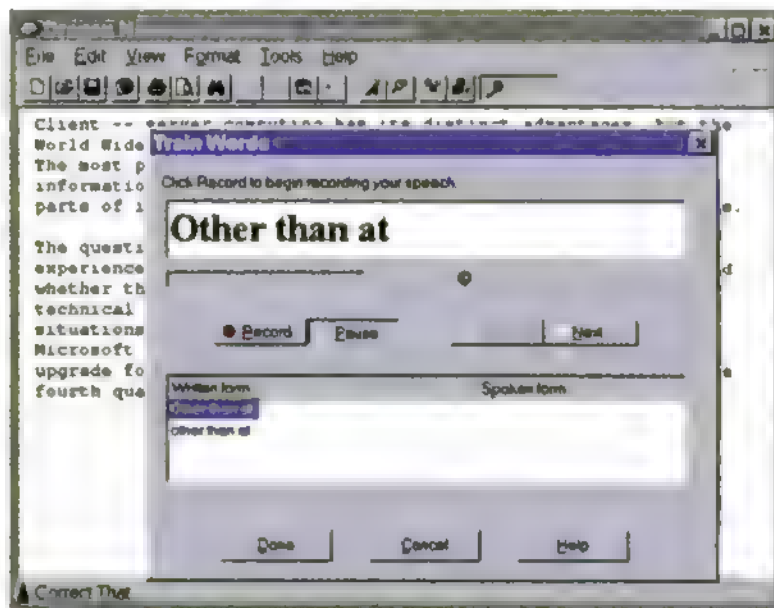
The only annoyance that we found was relatively minor—NaturallySpeaking refused to accept numbers spoken in a natural manner. For instance, saying "two hundred ten" resulted in NaturallySpeaking entering "20,010." Instead, you must say, "two-one-zero."

Dragon has added some new dictation and editing capabilities not found in its previous product, DragonDictate. You can spell words by saying the letters instead of using the alpha-bravo alphabet. Voice macros enable you to add long phrases to documents by speaking shorter ones. For instance, you could say "my URL" to have NaturallySpeaking insert the address of your home page.

DragonDictate compelled you to correct as you dictated, because it was clumsy to use voice commands for after-the-fact editing. NaturallySpeak-

ing, on the other hand, makes editing afterward just as simple as during dictation. To aid post-dictation editing, its new select-and-say feature highlights a word or phrase anywhere in the document if you say, "Select [word or phrase]." Typically, you'll have to edit your document after you dictate it; if you wish to edit your file orally, you have to learn the appropriate voice commands.

NaturallySpeaking is less flexible than DragonDictate in other areas. Instead of dictating directly into your applications, you must now dictate into NaturallySpeaking's text editor, which resembles Windows 95's WordPad. You can save your dictation in .RTF format or copy and paste it into your word processor using voice commands. Unfortunately, there isn't any macro to automate this transfer. Using this system also means that, unlike DragonDictate, NaturallySpeaking is no longer helpful for dictating into applications such as spreadsheets or databases.



**PERSONAL TRAINER:** You can train NaturallySpeaking to recognize and work optimally with your voice.

Another limitation is that NaturallySpeaking's text editor lets you have only one document open at a time. In addition, it supports only rudimentary formatting capabilities and does not include such basics as the ability to create tables or a spell-checker. You can use

voice commands to control NaturallySpeaking's editor, but NaturallySpeaking is unable to navigate within Windows 95 or other applications. In contrast, DragonDictate made it simple to perform tasks such as opening, closing, and switching among applications and using your voice to quickly position the mouse cursor.

NaturallySpeaking also suffers from a handful of other first-version rough edges. For instance, although you can conveniently switch off the voice engine with the command, "Go to sleep," NaturallySpeaking required about 20 seconds to wake up—even on our 200-MHz Pentium Pro PC with 64MB of RAM. The software required a similar amount of time to load the voice file upon starting the program and to recompile it upon closing. In addition, NaturallySpeaking crashed a couple of times on our tests, displaying indecipherable error messages.

Even though its interface needs polish and its scope is narrower than previous voice-dictation products, NaturallySpeaking is still a very impressive accomplishment. This package provides truly natural voice interaction with your PC. IBM and Kurzweil both have competing products coming to market; nonetheless, NaturallySpeaking is the first product to make speech recognition attractive to a wide range of users.

**Dragon NaturallySpeaking, Personal Edition 1.0.** Street price: \$200. Requires: 32MB of RAM (48MB for Windows NT 4.0), 60MB hard-disk space, Windows 95 or Windows NT 4.0, Sound Blaster-compatible sound card. Dragon Systems Inc., Newton, MA; 800-437-246, 617-965-5200; www.dragonsys.com. Circle 404 on reader service card.



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# First Looks

## DIGITAL CAMERAS

### A Twist in Point and Shoot

*Cameras from Minolta and Sony pave new ground.—By Daniel Grotta & Sally Wiener Grotta*

The Minolta Dimage V and the Sony MDC-FD7 Digital Mavica cameras offer a number of common features. Both cameras have 640-by-480 resolution, zoom lenses with macro capability, LCD viewfinders, removable memory, a built-in flash, a 10-second self-timer, automatic white balance, and manual exposure compensation.

Also, both products can produce superior quality, small-size images. But that's where any resemblance ends.

#### MINOLTA DIMAGE V

Slim, sleek, and sophisticated, the Minolta Dimage V (\$800 street) is compact enough to fit into a shirt pocket. All buttons and levers are conveniently clustered and clearly marked, so there's no uncertainty as to which one to push. One exception is the tiny on/off button; located behind the shutter release, this button is too easy to press inadvertently. Another is the delete button, which does not require confirmation in order to eliminate an image.

The Dimage V's lens swivels a full 180 degrees, letting the user take a self-portrait with ease. The fixed focus ("pan focus") lens zooms from telephoto to wide angle to macro with the push of a finger. The lens is unique in its ability to detach completely from the camera and tether to a 40-foot cable. A drawback to the lens design is its lack of either a cap or a protective slide, which means that the CCD (charge-coupled device) can be damaged if the lens is pointed at the sun.

The Dimage V stores images on postage stamp-size, SSFDC SmartMedia memory cards. The

camera comes with two 2MB cards, each of which can save 16 fine or 40 standard images. Images are then transferred to the computer



**SNAPSHOT:** Sony's Digital Mavica (left) and Minolta's Dimage V.

via an optional PC Card adapter or the included serial cable.

One noteworthy feature is the exposure compensation, which the user can adjust through a range of plus-5 or minus-5 full exposure stops to lighten or darken the picture. That's more than most professional 35-mm SLRs.

The Dimage V's images are sharp, well-exposed, and uniformly bright. Skin tones are accurate, and although color saturation is slightly subdued, it's well within an acceptable range. In all, this is an excellent, well-rounded device—though a bit on the pricey side for a digital camera at this resolution and with these features.

#### SONY DIGITAL MAVICA

Addressing the inconveniences associated with downloading images to a PC is Sony's MDC-FD7 Digital Mavica (\$799 list), the only digital camera that saves JPEG images directly to a stan-

dard DOS-formatted 3.5-inch floppy diskette. Each 1.44MB floppy disk can store 20 fine or 40 standard images; the counter displays both the number of exposed shots and the total capacity of the disk.

Transferring images is a snap: Simply put the diskette into any PC, open the pictures with any image-editing software, or use Windows Explorer to save them directly to any folder.

The Digital Mavica is larger and heavier than most entry-level digital cameras. It houses a 3.5-inch disk drive and a 2.5-inch LCD that can be used as the viewfinder (in the same manner as a number of popular camcorders). But the camera's ergonomic design and rubberized finger indentation make it easy to handle. All of the controls are large, well-marked, and conveniently placed. Deleting images requires user confirmation.



ion camcorder battery.

The Digital Mavica has a lens cap that's permanently attached to a cord and a visual-effects option that transforms your images into sepia, pastel, negative, and black-and-white images. The camera also offers automatic exposure-mode presets for certain subjects and lighting conditions. The only annoyance worth noting is the 10-second time lag it takes to capture, convert, and save each image to disk.

On our tests, the Digital Mavica's images exhibited excellent color fidelity and saturation in the skin tones and mid-range; they were slightly underexposed in less than ideal lighting situations. There was some aliasing, but the picture quality was quite good overall. Given the Digital Mavica's features, image quality, and unique ability to save to ordinary floppy disks, it's clearly the camera to beat in its price



**CANDID CAMERA:** Images captured by the Sony Digital Mavica (left) and the Minolta Dimage V.

and performance range.

**Dimage V.** Street price: \$800. Requires: 16MB of RAM, 20MB of hard-disk space, Microsoft Windows 3.1 or later. Minolta Corp., Ramsey, NJ; 201-825-4000; [www.minoltausa.com](http://www.minoltausa.com). Circle 406 on reader service card.

**MDC-FD7 Digital Mavica.** List price: \$799. Requires: Window 3.1 or later. Sony Electronics Inc., Park Ridge, NJ; 800-342-5721, 201-930-1000; [www.sony.com/mavica](http://www.sony.com/mavica). Circle 407 on reader service card.



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# First Looks

## SEARCH ENGINES

### AltaVista Gets Easier

Improvements to the powerful search engine make it more accessible.—By Don Willmott

Digital Equipment Corp.'s AltaVista ([altavista.digital.com](http://altavista.digital.com)) is usually described as being the most comprehensive search engine on the Internet, but also one of the hardest to use. With a series of interface and technology changes, however, AltaVista is setting out to present a friendlier face.

The first thing you'll notice is that AltaVista is now called the **AltaVista Network**. A clickable map at the top of the screen lets you log onto one of Digital's international mirror sites to speed performance and give better access to localized lan-

guages. This feature dovetails with the engine's stunning ability to look for content in any (or several) of 25 languages. If you ask AltaVista to return results in, say, French, German, and Italian only, that's just what you'll get. AltaVista uses true language searching; it doesn't merely guess that a site whose address ends in .fr is

likely to be in French.

AltaVista's new interface removes most advanced options from the main screen. When a search returns results, you can narrow the focus by simply refining the search.

The search engine categorizes search results by using keyword clues (Digital names the process "dynamic categorization"). And then you are able to click on the categories that narrow in

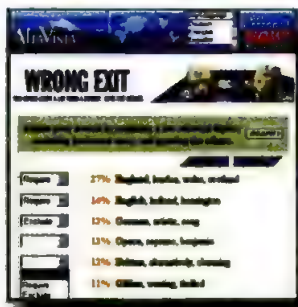
most directly on the concepts you want to study. If you search on a concept as broad as London, for example, dynamic categorization makes it easy for you

to sort through thousands of returned results to find the city of London, Ontario, as opposed to London, England.

Another way to achieve the same result is to work with an on-screen diagram that lays out a web of interconnections among the returned search results. The final version of this feature, which has been available since March, is smoother and more usable than earlier iterations.

AltaVista is still a search engine best used by Web surfers with experience, but these latest interface improvements will make its impressive searching power more accessible to users on all levels of experience.

**The AltaVista Network.** List price: free. Digital Equipment Corp., Littleton, MA; 800-336-7890; [altavista.digital.com](http://altavista.digital.com). Circle 405 on reader service card.



**POINT ZERO:** Refining a Web search using AltaVista.

## UTILITIES

### Power Indexer

Locate files on your hard disk and search the Web using AltaVista.—By Melissa J. Perenson

If you like using Digital's AltaVista Search Network, then Digital Equipment Corp.'s **AltaVista Search Personal eXtension** is for you. This new product extends the power of AltaVista's Web search engine to the desktop, enabling you to search both your hard disk and the Web from a single, unified interface.

You can perform a keyword search on your hard disk for documents, files, and even e-mail, and you can have the results returned in the familiar AltaVista summary format.

Building on the simple search interface of the AltaVista Search Network page, Personal eXtension couldn't be easier to use. You simply enter the word you're searching for, and the results are returned either as a two-line summary or as just the filename and date entries. Regardless of how the

search results are displayed, Personal eXtension provides direct links to those files.

You can conduct advanced searches by including Boolean operators and start and end dates, and you can rank documents based upon a user-designated keyword. You can opt to search your entire computer; limit your search to your e-mail, documents, or Netscape cache; or connect to the AltaVista servers on the Internet—all from the same local interface. Conversely, when you're on its search site, AltaVista recognizes that you have Personal eXtension installed locally and includes your local hard-disk search options in the pull-down menu.

The software installs itself as a proxy Web server, assigning a local port address to each index that's eligible for searching. Working unobtrusively in the background, the Personal eXtension Indexer examines your hard disk and indexes the full text of your documents. AltaVista uses Inso Corp.'s Outside In viewer technology to read and index files across the spectrum of over 200 file formats. Be prepared for indexing sessions to take a while,

eXtension offers indexing support for a variety of popular Internet e-mail packages—including Eudora, Microsoft Exchange Server, Microsoft Internet Mail, Netscape Mail Server, and Pegasus Mail—and your Netscape cache. The latter is a particularly convenient tool for Web surfers who'd like to find their way back to the site they vaguely remember visiting six weeks earlier. You can set these and other configurations by clicking a small icon in the system tray of your Taskbar.

The Indexer's automated polling feature makes it easy to schedule the day, time, and frequency of index updates, and you can select directories and drives that you don't want indexed. AltaVista also has versions of this software for work-



**SEARCH EXPRESS:** AltaVista Search Personal eXtension 97 lets you search your hard disk, e-mail, and Netscape cache.

groups and intranets. **AltaVista Search Personal eXtension 97.** List price: \$29.95. Digital Equipment Corp., Littleton, MA; 800-336-7890; [www.altavista.digital.com](http://www.altavista.digital.com). Circle 408 on reader service card.

As an added bonus, Personal





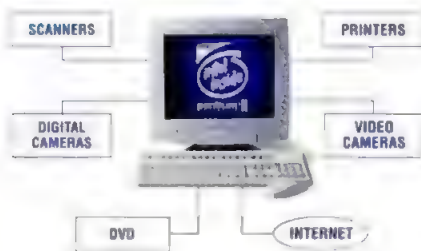
# Lights. Camera. Computer!

*Introducing Intel PC Imaging technology.*

The personal computer is seeing a lot of action in digital imaging these days. That's because the PC is now being used to capture, edit, store, communicate, and share still and video images.



film for capturing and downloading digital images. The miniature card's size and convenient package makes it easy to use in cameras and PCs.



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And Intel's work to advance the Universal Serial Bus (USB) provides plug-and-play connections and quicker transfer rates for digital cameras. We are simplifying connectivity and interoperability by developing industry design guidelines for a new class of digital cameras. We also support the FlashPix® file format standard to simplify image use across the Internet and software applications.

But this is merely a snapshot of what Intel has to offer. Get the whole



picture about PC Imaging

technologies and find out what to look for in a digital camera at our Web site.

► [www.intel.com/response/pcimaging2](http://www.intel.com/response/pcimaging2)

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The Computer Inside.™



# First Looks

## DIGITAL VIDEO

### Applying Special Effects

Adobe's After Effects helps you create eye-catching effects, composites, and more.—By Luisa Simone

**P**rimarily targeted at the broadcast-video and post-production markets, Adobe After Effects Production Bundle 3.1 (\$1,995 list) is a highly specialized, powerful application that excels at creating digital composites, 2-D animation, and special effects. In addition to the Production Bundle, Adobe offers a standard version for \$995. This version, which lacks such advanced tools as Motion Sketch, Motion Math, and Color Difference Keys, is aimed at graphic artists who want to supplement Photoshop's compositing tools.

The well-designed interface, which still resembles the look and feel of the Macintosh, includes three views: a Project win-

dow (where you assemble the source image files), a Composition window (where you position elements and preview the work in progress), and a Time Layout window (where you orchestrate the sequence of events and manipulate keyframes). These tightly integrated work areas help separate the spatial and temporal aspects of a project.

Unlike Adobe Premiere or Ulead Media Studio Pro, After Effects focuses on a single scene, building up layers of still images, digital video, animations, and even vector illustrations to generate a seamless composition. After Effects employs multiple user-defined keyframes to control a special effect at every point in the movie.

Two-dimensional animation is equally impressive; it combines the strengths of both keyframe and path-based animation. The Motion Sketch function lets you draw a freehand path, capturing both the direction and speed of your movements. To adjust either component is as easy as reshaping a bezier curve or moving the position of a keyframe in the timeline.

Best of all are the compositing tools. These supplement standard chroma key and transparency overlays with a Difference Matte (which compares a source video to a reference image and keeps only the differences) and Color Difference Keys (which create a gray-scale alpha channel mask to composite transparent elements onto a new background).



**THE GREAT DIVIDE:** After Effects divides the workspace into separate Project, Composition, and Time Layout windows.

After Effects lets you import a Photoshop .PSD file as a fully assembled and editable composition. It even maintains the relative position and transparency masking of each layer. You can also import Adobe Illustrator (.AI) files, which contain resolution-independent data that After Effects can animate and resize without degradation. During testing, however, After Effects crashed whenever we tried to import an .AI file. As a temporary solution, we removed most of the fonts on the system. A permanent solution will soon be available on Adobe's Web site.

Even with 64MB of RAM, real-time previews of motion effects are displayed as wireframes. Viewing actual footage of high-resolution images or .AVI files with audio slows down playback considerably, causing jerky motion and dropped frames.

Given the power it delivers, After Effects is guaranteed to produce a lot of excitement for both the professionals using it to make movies and the audiences viewing these movies.

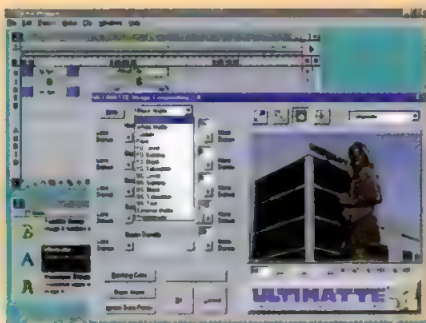
**Adobe After Effects 3.1 Production Bundle.** List price: \$1,995 (\$995, standard edition). Requires: 16MB of RAM for Windows 95, 32MB of RAM for Windows NT, 80MB hard disk space, Windows 95 or Windows NT 3.51 or later, QuickTime for Windows, CD-ROM drive. Adobe Systems Inc., San Jose, CA; 800-685-3504; 408-536-6000; [www.adobe.com](http://www.adobe.com). Circle 402 on reader service card.

## The Ultimatte Plug-In

**B**y using a technique called blue screen, it's easy to superimpose video footage of a foreground figure over a new background. But doing it so that detail is preserved, edges blend properly, and transparent objects let the new background show through is the hard part. **Ultimatte** (\$1,495 list), from Ultimatte Corp., consists of three plug-in modules for Adobe Premiere

and Adobe After Effects. It provides solutions to common blue-screen problems.

Ultimatte's Screen Correction transition filter utilizes a difference matte (a shot of the blank blue backing), which cancels out irregularities. The Grain Killer filter can remove noise in the backing without sacrificing foreground detail. A linear gray-scale mask automatically removes discolorations from the foreground subject.



**MAXIMUM MOVIES:** The Ultimatte plug-in from Ultimatte Corp. allows you to isolate and adjust different aspects of the composite—including editing the Black Matte directly.

Ultimatte lets you create and edit a matte by sampling colors in the source footage with an eyedropper. Still, it is not meant for amateurs. To get the most out of Ultimatte, you must understand advanced image-editing concepts. It also takes time to learn how the three filters work together.

Ultimatte requires a serious investment of both time and money. But for developers who

need to process large amounts of blue-screen footage, the payback comes in increased productivity and higher quality.—LS

**Ultimatte.** List price: \$1,495. Requires: Windows 95 or Windows NT 3.51 or later, 24-bit graphics adapter, Adobe Premiere 4.2 or Adobe After Effects 3.0. Ultimatte Corp., Chatsworth, CA; 818-993-8007; fax, 818-993-3762; [www.ultimatte.com](http://www.ultimatte.com). Circle 403 on reader service card.

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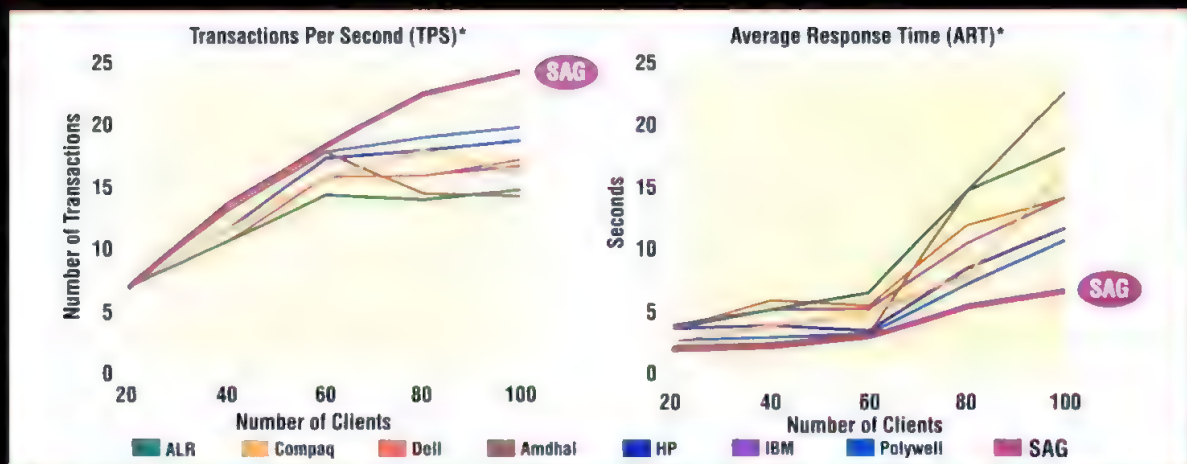
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\*Source: Network Computing Pro 4/97, 5/97, 6/97

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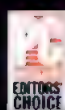
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Flowcharts





# Second Looks

## NET2PHONE

### Long-Distance Answer

**S**ure, there are plenty of discount long-distance calling plans out there, but most of them have major restrictions. With some, you can make calls only after 7 P.M. Others insist that you provide the phone company with your friends' telephone numbers. Many force you to pay a monthly fee.

Long-distance carrier IDT Corp. is looking to change all that. With Version 8.23 of its Net2Phone Internet telephony product, you can make calls to anywhere in the country at any time for just 10 cents a minute. The new version can be downloaded from Net2Phone's Web site at [www.net2phone.com](http://www.net2phone.com).

In our review of Net2Phone (First Looks, Oct. 22, 1996), we liked its interface and convenience, but unfortunately, sound quality was poor. In addition, it lacked an address book and full-

duplex support. In the new version, IDT has added a proprietary compression algorithm that improves sound quality enormously. Also, Net2Phone now provides full-duplex capabilities and a ten-number speed-dial address book.

Most of the calls sounded like they were being made on traditional telephone connections. You can switch from full- to half-duplex at any time, and you can press a mute button on the program's main interface if you want to complain to yourself about the long-winded person on the other end of the line.

Net2Phone is easy to install on any Windows PC. It features a telephone GUI complete with a virtual handset and number pad.

When you first start using the software, it gives you an identification number and a PIN code that you will need to enter before every phone call. So to call your mom, you would enter your PIN, dial her number, and press Call.



You must prepurchase \$25, \$50, or \$100 blocks to pay for your calls. The software dials into IDT's 800-number routing center and completes your call, debiting your card automatically.

You can hear the people you call through your PC's speakers and talk to them through your microphone. Most of the people we called didn't even know we were using a computer to speak to them. Those who did told us there was barely any break-up when we spoke with hard consonants.

We used the software to call Canada (13 cents per minute), England (18 cents per minute), and Japan (29 cents per minute). Our phone call to England connected immediately, and we found little perceivable break-up. Our experience calling Canada was similar. Connecting to Japan took a little work, though. We had to redial our number several times, but we finally managed to get through.

This fall, IDT is planning on lowering its domestic long distance rates to 8 cents per minute. —Karen J. Bannan

## NUTS & BOLTS

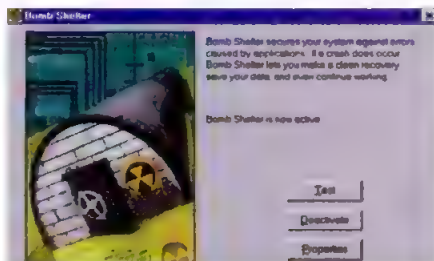
### Adding to the Essentials

**W**hen we first looked at Helix Software's Nuts & Bolts (First Looks, June 24, 1997), we appreciated its power, range, and flexibility. But we also noted its inconsistent keyboard interface, lack of shortcut keys, and inability to track changes to the Registry and compare files.

Helix Software has released a maintenance update to this \$50 utility (street price). Many of the changes found in Nuts & Bolts Maintenance Release 1.01 (available for download at [www.helixsoftware.com](http://www.helixsoftware.com)) merely supplement the base package, offering a host of features that were not included in the initial version. Other additions fix a hand-

ful of documented bugs that plagued Version 1.0.

Leading the improvements to Nuts & Bolts are subtle alterations to the interface, including



the addition of a command line and keyboard shortcuts to DiskMinder. The Registry wizard now lets you create multiple backups of your Windows 95

Registry and restore any version of the backup at any time.

One of the more troublesome bugs in Nuts & Bolts 1.0 involved DiskTune, a hard disk maintenance utility that was incompatible with large DriveSpace drives (defined by Helix as anything with 512MB or more). Even though there was

nothing wrong, the utility would report disk errors and prevent operation of the drive. Helix has now fixed this problem as well as the DiskTune problem, which caused out-of-memory errors, and the DiskMinder problem, which required two passes on compressed DriveSpace drives in order to fix certain size errors.

Version 1.0 also had difficulty

working with systems that had USB drivers installed. Now there's support for USB drivers under both Windows 95 and the Windows 95 Memphis beta (Memphis support has been integrated into the entire program). Also corrected is the Bomb Shelter crash protection feature, which conflicted with some games and caused a general protection fault error during Windows 95 start-up.

Maintenance Release 1.02, due this fall, will have even more corrections. A clean-up wizard that's better able to find unnecessary DLLs is in the works. Also expected is Zip Manager support for unencoded and MIME files. —Melissa J. Perenson

**SECOND LOOKS MAILBOX:** Tell Second Looks about your experiences with computer products. Contact Carol Venezia at [cvenezia@zd.com](mailto:cvenezia@zd.com).



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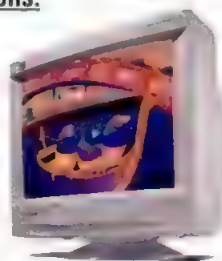
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# Torn Between Two Notebooks

**L**ife is good. I'm living with two new notebooks. They have vastly different missions, and both succeed beyond my expectations. I'm writing this on a new Toshiba 300CT subnotebook, while Gateway 2000's new 9100 model sits a few inches away. New notebooks cross

my path all the time, but these are truly exceptional.

I was really looking forward to writing this column. Not that I usually don't, but my Toshiba keyboard is such a pleasure that I can't resist the sheer sensual joy of tapping away on it. It's kind of like a guitar that's set up just right—fast, light action; not too much distance to the fingerboard; everything where you expect it to be.

Not that it's without idiosyncrasies. Having the Microsoft Windows button in the upper-right corner, in the function-key row, is a bit odd. The Fn key, in the lower-left corner, between the Ctrl and Alt keys, sees much less frequent use. The two could have swapped places easily. I haven't had a machine this small since the Gateway Handbook, which weighed in at 3.2 pounds, back in 1993. The 300CT is thinner and wider and weighs only 3.8 pounds. It's also thinner, less deep, and more than a pound lighter than the Toshiba Portege 610. The shorter depth of this machine means that you can use it with a tray-table while riding in coach, and the inconsiderate boor in front of you won't crush your screen into shards of glass and plastic when he reclines his seat.

The screen is dramatically different from that of most subnotebooks, too. I've had a 640- by 480-pixel color screen since the Gateway Liberty—a fine, light machine that still does honorable duty. My day-to-day machine is a Toshiba Portege 610, which has the best battery life of the Portege family. The 300CT is smaller, lighter, and has a 1,024- by 600-pixel screen, heretofore an unseen dimension. It's brighter, more saturated, and the resolution is a treat for the eye. Ten-point type in a Microsoft Word screen looks a little small, however. Keeping the magnification at 110 or 120 percent gives me dark, strongly defined characters that are comfortably large, even to my aging eyes. The 1K width lets me view multiple windows easily, without the constrained feeling of the usual 640- by 480-pixel subnotebook.

Still, the 300CT is for users who have lost their dependency on the 3.5-inch floppy disk drive. It's a road warrior's machine—but for the always-handly crowd, not the mobile

desktop bunch. This model doesn't even have a serial port unless you tote along the 4-ounce port expander, but it does have a high-speed infrared port for wireless docking. The included TranXit software has a redirector for wireless printing. On the downside, the 133-MHz MMX processor gets very warm, and the left side of the machine will take the crease out of your pants. But it runs cooler on its low-power battery setting.

I'm not usually a two-timer when it comes to notebooks, but that other machine is competing for my affections. Gateway's new Solo 9100 is vastly different. Compared with the 300CT, it's huge. This is a full-featured system that happens to weigh in at 9 pounds. And it's a better desktop than most. The 13.3-inch display is a full 1,024-by-768 pixels. It has a CD-ROM and a 3.5-inch floppy disk in just one drive bay. You'll also find at least one of every port you can imagine, including a MIDI/Joystick port, video in and out, infrared, and a pair of USB ports. You can go anywhere in the world and make a killer multimedia presentation with this machine. The MMX Pentium/166 and fast video hardware make it a great game machine, too.

I'm a MIDI buff, and I've installed a bunch of music software on the Solo 9100 and hooked it up to my Yamaha keyboard. Any notebook that conforms to the Windows sound system spec can squawk out a few notes, but the 9100 goes well beyond the usual, lame FM

synthesis to full wavetable audio.

Gateway pioneered wavetable chips in notebooks with the Solo 2200, but the Solo 9100 sounds better—nearly as good as my desktop's SoundBlaster 64. I play accompaniments that I've created with Band In a Box, the superb musical arrangement and accompaniment software from PG Music. The quality is sufficient for demo recording, and it sounds very good through my Cambridge SoundWorks speakers—the audiophile's choice.

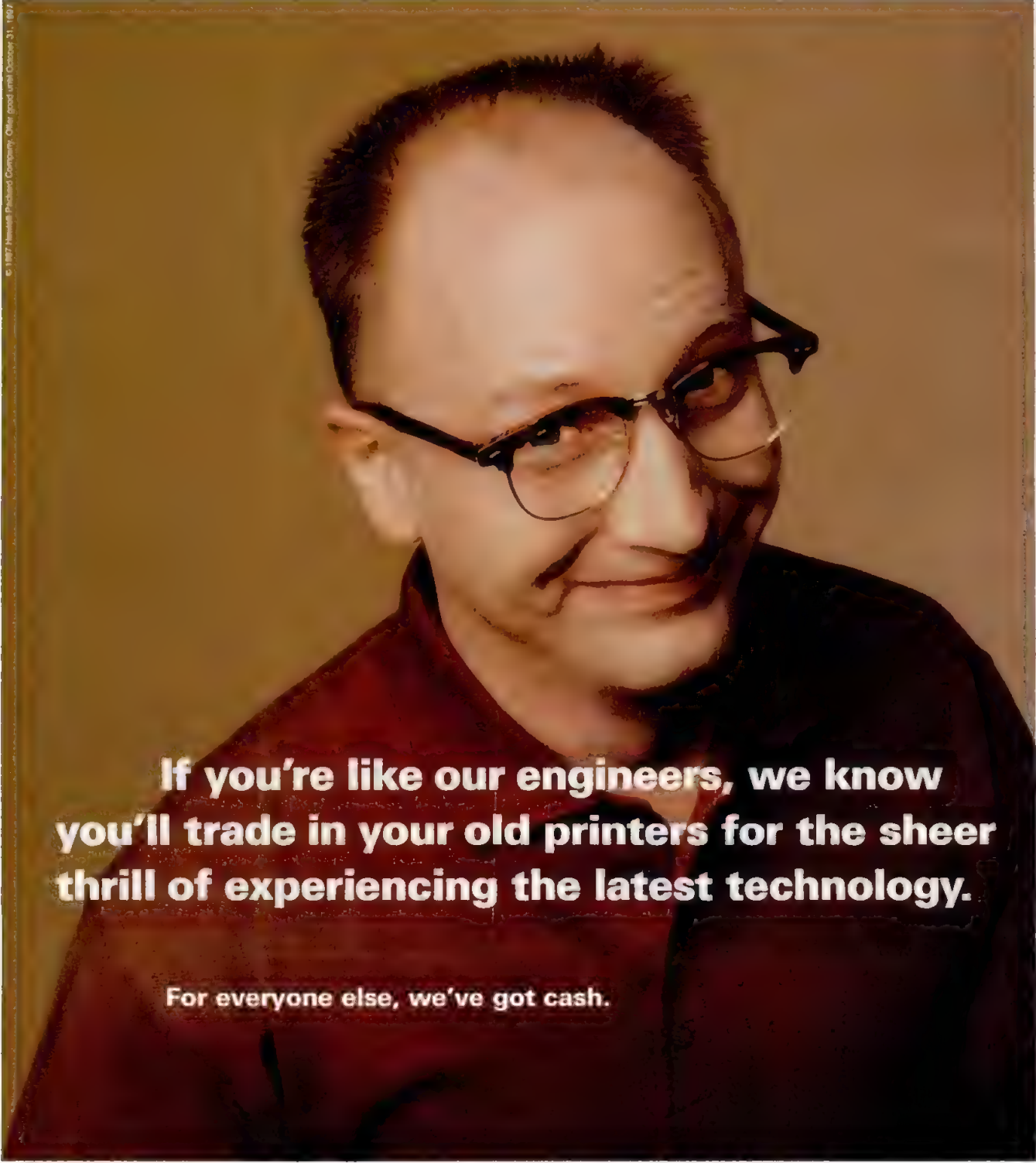
I, for one, am thrilled that the notebook market has finally gotten big enough to encompass many different user needs and preferences—including mine. **PC**



## TWO-TIMER

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one's little,  
but both  
have a  
share of my  
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# Talk About Pop Music

Each time there is an advance in computing power, something new comes along to take advantage of the technology. The latest trend is the use of MPEG-2 audio stream layer-3 compression to compress popular music for easy Internet distribution. Typically,

you need a Pentium with at least 90-MHz muscle to decompress the songs in real time. Most of the activity is done without the blessing of the music industry, which seems clueless as to how to proceed.

Here's what you need to know: First, note that the reference to this technology is always "MP3." If you go to a Web search engine and type in MP3 as your search criterion, you'll be inundated with various sites extolling the virtues of this scheme. You'll also find the players and lots of music. There are a dozen or so shareware and freeware players of note, such as WinPlay3 (the original Windows player), WinAMP, MPlayer, and others. I use MPlayer because it can turn an MP3 file into a .WAV file. Aficionados believe that WinAMP is the best out there.

MP3 songs are compressed digital files that play as .WAV files. The compression ranges from 10:1 to 14:1. Proponents claim no degradation in sound quality from uncompressed CD audio. The rule of thumb for MP3 is 1 minute of CD music per megabyte. A CD containing MP3 audio can contain 14 hours of music. A single-sided, single-layer DVD would thus hold about 100 hours of music. A quad-density DVD might contain as much as 400 hours. One such disk could potentially play music 24 hours a day for more than 16 days before repeating.

College-born, MP3 has spread through universities here and abroad, with Stanford and Texas A&M students doing most of the promotion. Numerous "Web rings" around the world serve as semiprivate clubs where music is freely traded. There are also lots of FTP sites that many typical computer users can't fathom. I have not been able to penetrate this underground enough to say that I've seen a disk for sale.

Many of the music sites are trying to get ASCAP approval for downloading, saying they are an Internet form of radio with a music-on-demand function. Other sites are trying to promote a "test-drive" concept where you can listen to cuts from albums to help you decide if you want to buy a legitimate CD. Many underground labels are

considering the use of MP3 as a marketing tool.

The big publishers are flat-footed, as usual. Last June the RIAA sued three Web sites for copyright violations, and now most of the archives are deep underground or offshore. But for every site sued, about ten new ones emerge. Most of

these sites don't care about getting sued; they're judgment-proof Generation Xers and college kids who spent all their money on a server and a T1 connection.

If you want to get into the thick of this trend quickly, I'd suggest you go directly to EFNet, DALNet, or Undernet on Internet Relay Chat (IRC) for starters and just "join" MP3. You'll quickly see what's going on. For the most part it's kids swapping music samples that seem otherwise unobtainable. While the music industry moans and groans, it obviously isn't doing the job needed to get contemporary music for sale into the hinterlands.

This concept is not going to disappear, and the record companies should look at this as a new form of distribution. They should look if for no other reason than to protect the integrity of the source material. Most of the music converted to MP3 is handled by amateurs, very few of whom are audiophiles. So some songs are overmodulated or poorly decoded in the first place. Not all recording artists want to sound like garage bands.

I believe this kind of thing will encourage consumption. But it will also encourage record companies to stop ripping off the public with poor-quality CDs that have

one good song and 13 turkeys for \$14. And while I don't expect to see commercial MP3 CDs any time soon, I suspect that someday we'll see some of the larger collections put on single MP3 disks. While the Beatles can get away with selling nine disks or more in an anthology package, others can't.

Although no standalone player can play an MP3 CD, there is no reason to suspect that in the future enough horsepower can't be crammed into a player to play MP3 audio straight from a disk. The market potential is huge. Not many people will buy a 45-minute rockabilly CD from the 1950s for \$16. But how many might buy every rockabilly song ever done for \$16 on a 14-hour disk? My guess? Lots of people.



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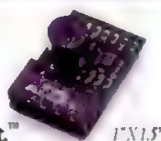
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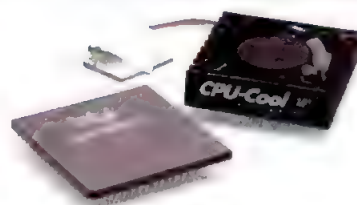
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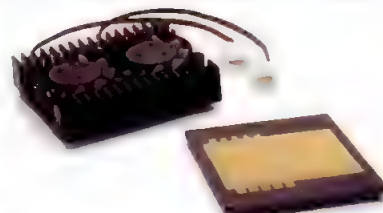
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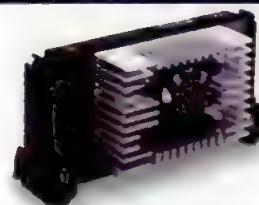
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# Inside Track

**A** recent edition of *The Microprocessor Report* tells of the **woeful situation** that has beset the microprocessor industry. Nobody can sell a non-MMX chip anymore. Thus, prices have collapsed, **screwing up** everyone's marketing schemes. The good news is that the consumer will have more computing power for even less money than anticipated. Consider upgrading over the next few months if you haven't got at least 166-MHz speed. I expect to be running a **300-MHz** clock by January 1998.

**Insiders tell me** that when AMD rolled out its 233-MHz K6—thus leapfrogging Intel for the first time in about a decade—Andy Grove hit the ceiling and vowed that such a thing would never happen again. But AMD engineers hope to leapfrog Intel again within the next 12 months. I have no idea what kind of speeds we're talking about, but **400 MHz** keeps getting mentioned.

**Weird Item in the Consumer Electronics Summer Report.** CEMA (the Consumer Electronics Manufacturing Association) produces an interesting publication called *U.S. Consumer Electronics Industry Today*. In it you find what the big boys are planning to introduce and what markets they expect will open. The report tends to be right on the money, although it also hangs on to dubious technologies, such as that little Sony MD-format minidisk, for which there are still **high hopes**. The most interesting device expected to hit the stores this year is something called **D-VHS**, a **digital VHS recorder** that can download a data stream from a DBS satellite. CEMA expects this device, which has a capacity of 44.4GB of storage per tape, to be incorporated into what it calls *central home servers*. This, for an audience of users who can't set the clock on a VCR. Yeah, right.

Looking at 6-mm digital camcorders, I see that all of these new digital devices use the IEEE-1394 **FireWire standard** for I/O. D-VHS will incorporate it, too. But since few computers use this circuit (or USB for that matter), you have to wonder what the psychological effect will be if the early-adopted standards set by the consumer electronics industry will drive the computer business. **Not a good effect**, I'm sure.

**Genuinely Interesting Software Dept., Web Management Division:** This is without a doubt the **single best** Web-page layout and development tool I have ever seen. **Don't think twice about buying it.** It kicks the stuffing out of FrontPage—and I like FrontPage a lot. It's called WebExpress, from MicroVision Development, a company that makes an award-winning word processor called WordExpress. MicroVision uses

*Nobody can sell a non-MMX chip anymore. Thus, prices have collapsed, screwing up everyone's marketing schemes. The good news is the consumer will have more computing power for even less money than anticipated. Consider upgrading.*

its own WYSIWYG technology and includes all site-management functions. More important, the **pages are compact** and easy to edit with a plain ASCII editor. Most visual Web-page editors create **monstrosities** that cannot be easily edited with any plain HTML editor. At \$70, I consider WebExpress the **bargain of the decade**. Call the company at 760-438-7781 (760-438-0305 internationally) to order a copy. Its Web site is [www.mvd.com](http://www.mvd.com). I do all my pages ([www.dvorak.org](http://www.dvorak.org)) with this product, and my 11-year-old has put up some weird and interesting pages ([www.rubblezone.com](http://www.rubblezone.com)) using it. Even Bill Machrone is a fan. Highly recommended.

## **Genuinely Interesting Software Dept., Image Management Division:**

As any of you who like to play with Web pages know by now, your collection of .JPGs and .GIFs gets **unwieldy** rather quickly. To manage images I use the fantastic ThumbsPlus 3.0, from Cerious Software. ThumbsPlus creates thumbnails and manages all of the pictures (including fonts) on your drive—including the most **obscure** image types. I first saw this product some months back when I got a Kodak DC-120. When Kodak changed the format of its .KDC files, I asked Phillip Crews, ThumbsPlus's designer, if he could make ThumbsPlus see the new format. Nothing else would. The new version is the result of his **adding that capability overnight**. He is one of those guys who seriously understands picture formats. ThumbsPlus has **too many cool features** to list, including a quick Web-page wizard that links a thumbnail on a Web page to its full picture so that you can put a photo album online. You can buy ThumbsPlus for \$70 direct from Cerious (704-529-0200) or download it for \$60 from the Web site [www.cerious.com](http://www.cerious.com). Believe me, you need this product if you have image files. Unequivocal recommendation.

**Genuinely Interesting Web Site Dept.:** A new category! Many of you do a lot of research using the Web as a resource. Typically, you go to various search engines and hope to find a cache of links someone has established, then hope that the links are exactly what you're looking for. The problem is that much published information is still stored in corporate archives or not generally available on the Web. When I'm doing **serious research** and want to look at almost every important news article and magazine article in print and archived, I skip the middleman and go to the Infonautics E-Library. It's amazing what you can find. So when people say that they "**can't find anything**" on the Web, send them to [www.elibrary.com](http://www.elibrary.com). There is a \$60 annual fee, with a 30-day trial offer. **Highest recommendation.** **PC**



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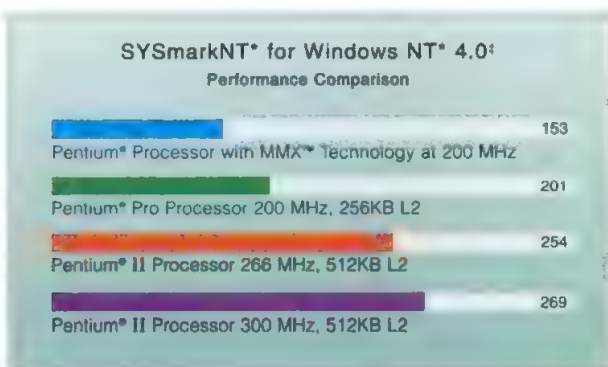
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# Building Web-Sites: A Top-Down Job

**T**op-down or bottom-up? Which way do you work? That division has become a kind of litmus test in business over the past few years. Those who believe in a top-down approach—ideas, programs, and plans hatched by management and then handed down the

corporate food chain to be executed—are often seen as mean, oppressive, and old-fashioned. Bottom-up—with new programs and the authority to create and manage them bubbling up from the lower ranks, in a *process-process* fashion—is very much in vogue, a hallmark of New Age enlightened management.

Of course, life is rarely so easy or so simple. Some projects require a top-down approach, while others work best bottom-up. One venture I'm entirely comfortable putting in the top-down category is building a Web site.

Unfortunately, few of us do it that way. Instead, we sit down and start fooling around with graphics we might use, maybe taking a few whacks at a logo—business or personal. Or we fire up Hot-Dog, or maybe just Microsoft Word, and start building some trial pages. Jump out to a Web browser to take a look at the results, jump back in to edit the page. Okay, save that one; now, let's try another. Hey, time to create some more graphics!

You don't create a real Web site by building pages, and you don't create it by beginning with Photoshop. Just as realtors endlessly preach the importance of "location, location, location," experienced Web people preach "structure, structure, structure."

Unless your nascent Web site has *coherence*—a reason to be, consistent execution that supports that reason, and easy, logical navigation across a plausible organizational structure—it's going to be a mess. And few visitors will return after first encountering your monster.

Sad to say, the tools we use to design, construct, and manage Web sites aren't much help in this dilemma. Many of them actually encourage random page-building and graphics-diddling—a classic bottom-up approach—thus making the problem worse. Work with these tools for a few hours and you'll have a directory full of random HTML files and GIFs, and maybe JPGs. None of this makes much sense, let alone a whole.

I don't know any software that can help much with the "reason to exist" step—the forethought that leads to a well-

defined, cohesive Web site. You've got to handle that yourself, and I pray that you will, because to steal a line from corporate trainer Dugan Laird, "Unless you know where you're going, you're certain to wind up somewhere else."

But once you do know where you want to go, I can recom-

mend two top-down Web-site toolkits to guide you through that structure-building process. They can keep you focused on what you should be working on next—and after that, and after that. Both also provide great tools for the more obvious site-construction tasks.

The first, and better, of the toolkits is NetObjects Fusion 2.0. Fusion, or at least early pieces of its code, first got our attention as the system used to build Rick Smolan's "24 Hours in Cyberspace" site-cum-book back in February 1996. NetObjects has created what, to my mind, is by far the best Web-site construction and management kit in existence. It used design tools devised by Clement Mok, an awesomely talented designer who's done many high-profile Web sites (as well as notable print and CD designs), plus technological underpinnings from two Apple expatriates, and an MBA and former McKinsey consultant on-board to hold the creative team's feet to the fire.

Fusion relies on a hierarchical view of your Web site. As you drill down through the hierarchy you create, the kit helps you assemble pages with a wonderfully consistent look and feel, thanks in no small part to a library of elegant page templates and

graphical objects. You assemble pages by dragging and dropping elements on a grid created by Fusion and the template you've chosen; Fusion writes the HTML code required to deliver that design to your site visitors. You can stray outside the bounds of a template—or build your own—but of course, you do so at your own risk: The results will look as you intended, but you won't be saved from instincts toward ransom-note design excesses.

Version 2.0 adds more templates, is easier to use, and, perhaps best of all, now lets you easily add frames to your site. (Those who believe that frames are the work of the devil need not write to tell me so; that view is already well



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## JIM SEYMOUR

represented in my reader mail.)

Fusion also elegantly handles the job of moving your completed site to a staging server (if you wish), where you can look at it through the eyes of a visitor, and then to the server at your ISP or hosting service.

At \$495, NetObjects Fusion isn't the right product for someone building a one-page personal Web site. But for anyone planning a Web site on a larger scale—not necessarily huge, just more than a few loosely related personal pages—Fusion is worth pulling out the plastic.

The other great Web-building package that encourages top-down, structured site development is, of course, Microsoft FrontPage 97. At just \$149, FrontPage is a screaming bargain. Its tools are less elegant and less intuitive than Fusion's, and it doesn't work as hard to keep you on a structured path. The toolkit is at its best only with ISPs and hosting services that provide the server-side FrontPage Extensions. But this is an extremely good product, robust and capable—more powerful, probably, than you'd expect. I know more than a few corporate developers who use FrontPage to spin out fast sites.

If you've adopted Microsoft Internet Explorer 4.0, FrontPad—the "FrontPage, Jr." or "FrontPage Express" that comes free with Explorer—is an even bigger bargain, though more limited than FrontPage 97 and, regrettably, less obsessive about top-down site-building.

A final note on building sites packed with HTML pages. Though many products, including these two, claim to build perfect HTML pages without the user knowing a thing about the language, I've yet to find one that writes flawless, never-needs-a-tweak code. A basic knowledge of HTML is very helpful, so you can go into the source code of your pages (or pages from other sites that you've captured to see how they work) and fiddle with the raw code. When, in your theoretically finished page, one word in a text-block changes to bold—but then, everything else from that place on the page stays in bold-face—it's important to be able to drop the correct HTML code in at the right point.

HTML is a feeble, infuriating language to use, but that also makes it remarkably easy to learn. The best of many introductions I've seen is Dick Oliver's *Teach Yourself HTML 3.2 in 24 Hours* (Sams), an engaging series of 24 one-hour exercises that will make you more than comfortable with HTML, if less than a world-class expert. **PC**

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# Freedom of Choice

Looking through a shoe box of long-forgotten receipts, I came across the mail-order sales slip for the first single-lens reflex camera I ever bought. Thirty years ago this summer, I sent off a \$300 money order to New York City on a Wednesday and my

Nikkormat FT arrived by special delivery on Saturday. At a time when local photo stores grudgingly offered 10 percent off to professional photographers only, 47th Street Photo and the other mail-order advertisers in *Popular Photography* were giving discounts of 25 percent to everyone.

"Mail order" is now called *direct marketing*, and it's a huge business that has forced local retail to become a lot more competitive. Consider the selection at a computer superstore—it's simply mind-boggling. But, even so, the selection's not as good as it could be, and I fear there's going to be some backsliding this year that will directly affect the onesie-twasie buyers selecting PCs for home or small businesses.

Here's the problem: The mantra in retail these days is, "fewer SKUs, more velocity." An SKU is a *stock-keeping unit*, and it means one configuration in one box. A mini-tower system with a Pentium MMX/200, 32MB of RAM, a 6GB hard disk, a 16X CD-ROM drive, and 4MB of graphics memory is one SKU. The same system in a desktop case is a second SKU; with a Pentium II and a 9GB hard disk, it's a third SKU. Retailers this year want fewer than half a dozen PC SKUs per vendor—often just three or four, which may be half the SKUs offered a year ago. The idea, from the retailers' perspective, is to sell those SKUs quickly, hence *velocity*.

Buying patterns tend to fall along somewhat predictable lines. It's unlikely you'll want to combine a 166-MHz CPU with 64MB of RAM and a DVD drive. But you may not be able to find what you want in stock if you're a small business or individual buyer. I can see buyers looking for a choice among, say, four CPU configurations, three hard disk sizes, two CD-ROM/DVD types, two memory configurations, two graphics adapter configurations, two levels of audio, two case types, and two software bundles (home consumer, small business). That's 768 possible permutations and perhaps two dozen serious configuration options that might make sense to you as a consumer.

Of course, if you're a corporate buyer, there's no problem with customization. Compaq, Hewlett-Packard, IBM,

and others are gearing to custom build PCs on demand. But we're talking about runs of dozens or hundreds of PCs if you want build-to-order configurations, or BTOs, done at the factory. Or, the retailer or VAR (value-added reseller) can open the box and reconfigure the system or add options.

This is often called *configure-to-order*, or CTO. But I believe the cheapest, best, least problematic way to build a PC is what's called *one-touch configuration*, meaning that the box is touched (opened) just once before it reaches the end user. Every time you open the unit and the packaging to add a Zip drive, more memory, or a network card, there's a chance that something will go awry. By comparison, when you call a direct vendor, a custom configuration run starts with a quantity of one.

Still, there have been changes in the manufacturing and selling process that will benefit consumers. Early this summer all the major retail vendors announced price cuts of as much as 25 percent on select models and at least 10 percent on most models, a move that brought pricing in line with or below the prices then offered by direct leaders Dell and Gateway 2000. At the low end, you now can buy a passable starter PC with a monitor for \$1,000; at the high end, you'll be seeing killer 266-MHz Pentium II systems for \$3,000, in some cases with 64MB of RAM and 9GB hard disks. To get prices this low, every manufacturer is adopting the just-in-time manufacturing technologies

used by Dell and Gateway (these are the lean manufacturing techniques first pioneered by the Japanese auto makers). Inventory that used to sit in a warehouse for a month or two is now delivered the week or even the day the computer is assembled. As a rule, components and finished PCs lose about 1 percent of their value for every week they sit unsold.

When Compaq rolled out its aggressive marketing stance in July, vice president Mike Winkler said, "You don't have to be direct to beat direct." The initial side benefit of this new strategy is more competition and better prices at retail. Whether you'll find the PC you really want remains to be seen. At the least, your ideal PC is just a phone call away. **PC**



**YOUR CHOICE**  
Buying patterns tend to fall along somewhat predictable lines.



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# OLD BOY'S NETWORK?

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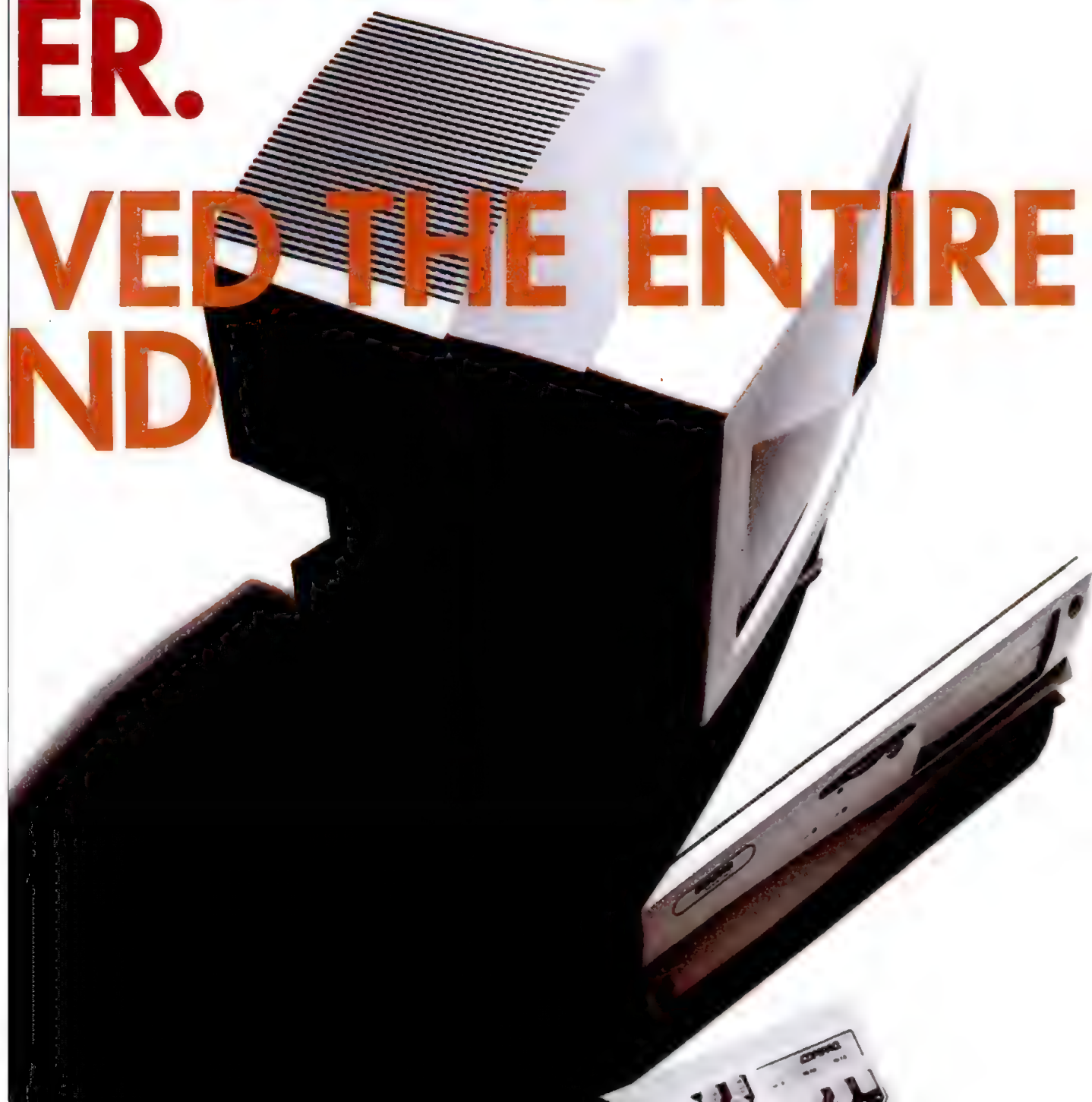
**THE COMPUTER.**

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**ND**





By Carol Venezia

# THE TWO FACES OF

**T**he days when the fastest processors were put to work only in bleeding-edge and astronomically expensive computers are unquestionably over. Driven principally by our ever-increasing need to create, display, or otherwise manipulate bigger images—be they still, moving, 2-D, or 3-D—vendors that build these CPUs recognize that the phrase “affordable power” can no longer be an oxymoron. We need the horsepower now just to get the job done. Enter the 300-MHz Pentium II.

When Intel first introduced the 300-MHz Pentium II—essentially a faster Pentium Pro with MMX extensions—in May, it was priced at a stratospheric \$1,981, putting it out of reach for mainstream PC buyers. Recent pricing moves have brought this chip back down to earth: At the end of July, Intel cut the price to \$851.

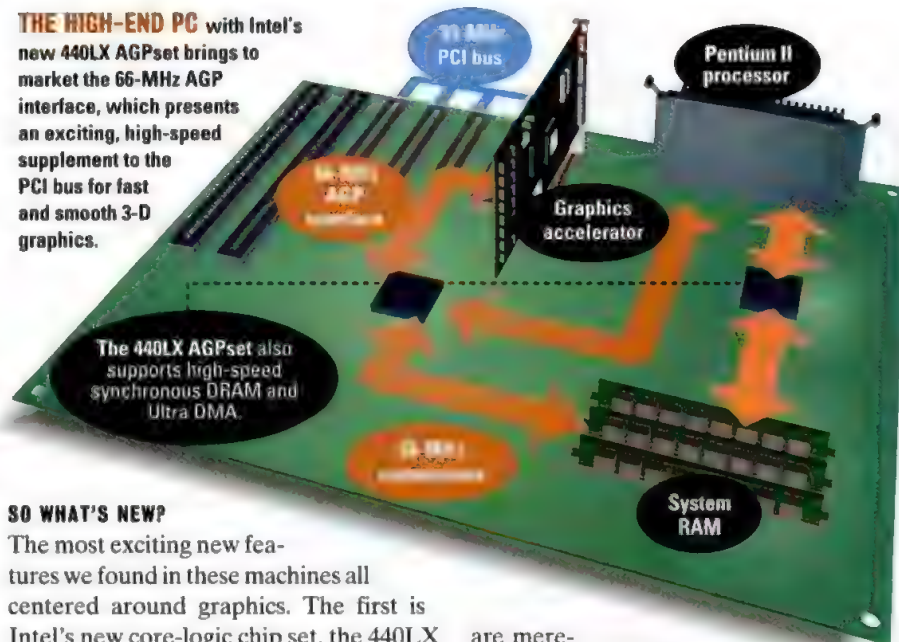
That translates to affordable power. The average price of a high-end PC in this roundup is about \$3,500. The workstations are a bit more expensive (about \$6,000 without monitor), but they also support OpenGL graphics.

## REVIEW CRITERIA

For this roundup we gathered two types of systems: high-end PCs for mainstream users and personal workstations for 2-D/3-D graphics and OpenGL applications. For a high-end PC, we required Intel's new 440LX chip set and an AGP (Accelerated Graphics Port) graphics board. We also asked for 64MB of RAM, a 4GB hard disk or better, and Microsoft Windows 95. A workstation had to have an OpenGL graphics board with at least 16MB of memory, 128MB of RAM, a 4GB SCSI hard disk or better, and Windows NT 4.0.

This netted us eight units: five high-end PCs and three workstations. Compaq, a major player in the PC workstation market, was unable to provide us with a system in time for testing. (A review of the Compaq Professional Workstation appears in this issue's First Looks section.)

**THE HIGH-END PC** with Intel's new 440LX AGPset brings to market the 66-MHz AGP interface, which presents an exciting, high-speed supplement to the PCI bus for fast and smooth 3-D graphics.



## SO WHAT'S NEW?

The most exciting new features we found in these machines all centered around graphics. The first is Intel's new core-logic chip set, the 440LX AGPset. With this chip set, Intel aims to bring the x86-based PC platform fully into what the company dubs “the era of the visual connected PC.”

At its lowest level, the 440LX chip set surpasses its predecessor, the 440FX, on several counts. It supports synchronous DRAM for faster data streaming between the CPU and I/O devices.

There's also Ultra DMA support, which enables faster IDE-device transfer rates.

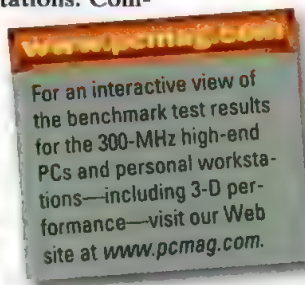
Although these features certainly enhance the platform, you're probably asking yourself what all of this has to do with the visual connected PC. These features

are merely the foundation: The real story behind LX is AGP.

## AGP DEBUTS

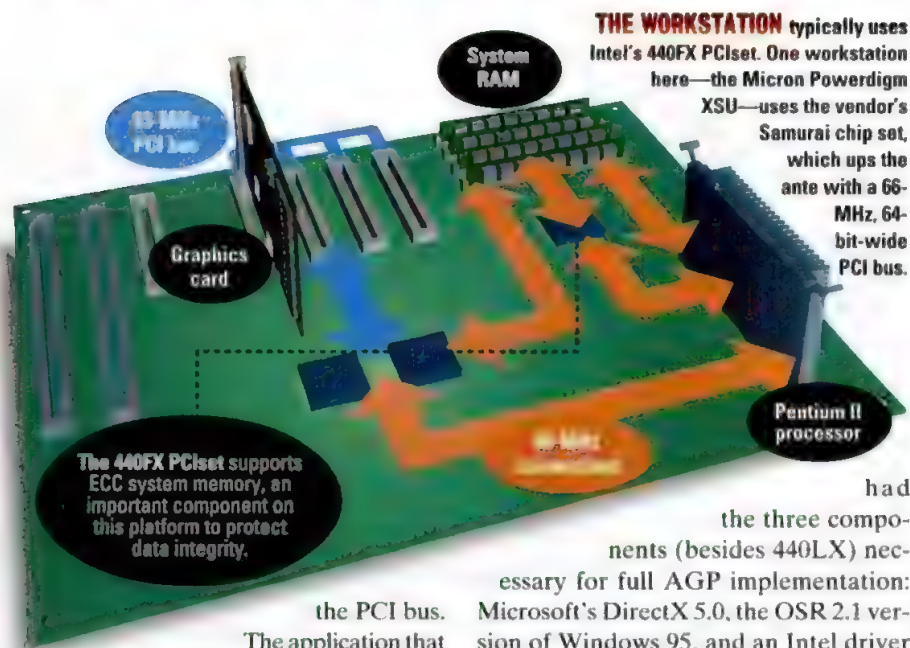
AGP technology provides a 66-MHz pipeline between the 440LX chip set and the graphics processor in order to boost system performance. But it's not simply speed that makes AGP compelling. The more important function AGP performs is pulling the graphics accelerator off the PCI bus.

To be blunt, the PCI bus is maxed out. Between powerful 2-D and 3-D graphics cards and high-speed I/O devices, the PCI bus went from being a boon to being a bottleneck. AGP is a good start toward addressing this problem, given that the graphics board is the biggest resource drain on



# 300MHz

PC Labs puts the 300-MHz Pentium II processor to the test with five high-end PCs featuring AGP graphics support, plus three OpenGL workstations.



**THE WORKSTATION** typically uses Intel's 440FX PCIset. One workstation here—the Micron Powerdigm XSU—uses the vendor's Samurai chip set, which ups the ante with a 66-MHz, 64-bit-wide PCI bus.

Dell and Gateway and the Diamond Viper V330 AGP used by Micron. With these boards, the three PCs turned in scores on our 3-D graphics WinMark and AGP tests nearly double those of their competition.

## THE WORKSTATIONS

Thus far, our discussion about the hot new features in the Pentium II world has centered around the high-end PCs here. That doesn't mean that there's nothing going on in the workstation market. On the contrary: There's plenty of action, thanks to finely tuned and well-developed hardware and the addition of new, heavy-hitting players such as Dell and Micron.

Workstation graphics are a different ball of wax from PC graphics. The workstations here all use graphics boards with at least 16MB of memory; surprisingly, they all cost about \$6,000 to \$7,000 with 3-D graphics boards. This is a far cry from our last graphical workstation roundup (in our issue of April 22, 1997), for which we tested similarly configured dual-CPU Pentium Pro units; all of those cost in excess of \$10,000. Even better, the Pentium II systems we tested here

the PCI bus. The application that should make AGP shine is 3-D graphics. Not only is AGP running on a faster bus, it also allows for a direct 66-MHz pipe into system RAM in order to process large texture files quickly. With PCI graphics boards, transfers of texture bitmaps from system RAM to the graphics board have to cross the slower 33-MHz PCI bus. (For an explanation of how AGP works, see "Introducing AGP.")

Simple? Well, not quite. PC Magazine Labs' experience with testing AGP proved that new technologies may be exciting, but they rarely come without headaches.

## TESTING WOES

Before we ran our 3D WinMark AGP test, we checked that all high-end PCs

had the three components (besides 440LX) necessary for full AGP implementation: Microsoft's DirectX 5.0, the OSR 2.1 version of Windows 95, and an Intel driver (VGARTD.VXD) that lets the graphics accelerator communicate directly with system memory for rendering large textures.

After spending many hours upgrading DirectX (which finalized after testing began), reinstalling VXD drivers, and experiencing countless "blue screens of death," we got most everything to work. One machine, the Gateway G6-300XL, just would not run our AGP test.

So what did our test results show? In general, we found that AGP performance depends as much on the graphics engine as it does on the implementation. The star 3-D performer of this roundup was nVidia's Riva 128 engine, found on the STB Velocity 128 3D AGP board used by

## IN THIS REVIEW

|                                    |          |
|------------------------------------|----------|
| AST Computer .....                 | 102      |
| Dell Computer Corp.....            | 108, 116 |
| Gateway 2000 Inc.....              | 108      |
| IBM PC Co.....                     | 117      |
| Micron Electronics Inc.....        | 113, 119 |
| NEC Computer Systems Division..... | 116      |



**Our Contributors** NICK STAM is a technical director for PC Magazine Labs. CADE METZ is a staff writer, BRUCE BROWN is a contributing editor, and BRETT KRASNOVE is an editorial assistant for *PC Magazine*. CAROL VENEZIA was the senior editor in charge of this story, and LAURA COX was the project leader.

outperform the Pentium Pros we've recently tested.

So what about AGP for this platform? Many vendors would argue that it just isn't needed. AGP will work well in affordable solutions that focus on "light" 3-D rendering. However, when you move into the workstation realm, with applications such as Softimage 3D Extreme, you're talking about serious graphics processing that demands fast and big on-board frame buffers. The bottom line is that graphics acceleration executed entirely within hardware is just plain faster than a solution that relies on off-card system memory accesses.

The most exciting feature of the workstations was found in our Editors' Choice, the Micron Powerdigm XSU. This machine is the first to market with a 66-MHz, 64-bit-wide PCI bus, enabled by its Micron-designed Samurai chip set. Samurai also supports 1GB of SDRAM, and showed a performance advantage over the other workstations using Intel's 440FX chip set.

#### POWER TO THE PEOPLE

Whether your applications and computing needs dictate that you use a worksta-

tion or a high-end PC, the 300-MHz Pentium II is more than capable of delivering the horsepower that you'll need. With these machines, you'll get smoother video, and sharper and quicker graphics. And you won't have to break the bank to buy the fastest that the x86 world has to offer.

#### 300 MHz Pentium II

## High-End PCs

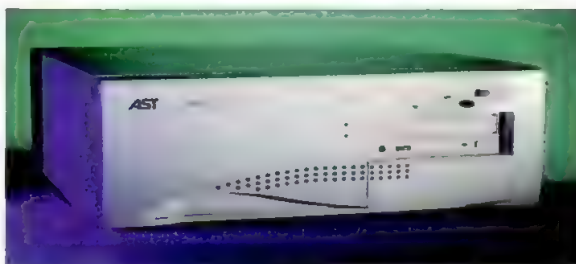
### AST Bravo MS 6300

Thanks to two innovative features, the AST Bravo MS 6300 (\$4,080 street), is not only easy to service, it's easy on the ears. This PC uses an NLX design; you can remove the chassis cover with the push of a

button and slide out the motherboard with the flip of a lever. The Bravo also features what AST calls System Noise Reduction technology, which cuts down noise generated by the machine.

The Bravo's graphics board (the ATI 3D Rage Pro AGP) produced a Business

Graphics WinMark 97 result which, while fairly competitive overall, was below that of the leader, NEC. On both the 3D Graphics WinMark and 3D Graphics WinMark AGP tests, the Bravo finished slightly above the NEC machine, but almost 40 percent below its nVidia-based



AST's Bravo features an easy-to-service design.

## Introducing AGP

By Nick Stam

**A**t the Spring 1996 Windows Hardware Engineering Conference (WinHEC), Intel announced its Accelerated Graphics Port (AGP) technology. More than a year later, the first systems that use the technology—as well as Intel's new 440LX AGPset—are here, powered by Intel's Pentium II processor. The intent of AGP is to enhance the quality, frame rate, and interactivity of 3-D applications.

#### HOW IT WORKS

Fundamentally, AGP is a high-speed point-to-point connection between the system chip set and the graphics chip. AGP was developed to provide graphics subsystems with a cost-effective and rapid path to large amounts of system memory for 3-D rendering.

Using the AGP connection, the graphics chip can access system memory directly through the system chip set at memory-bus speeds, reducing latency and increasing performance compared with PCI transfers. The system chip set must support AGP transactions, and the graphics chip must be built to

communicate, via AGP protocols, with the system chip set. When performing certain AGP operations, the operating system must be able to allocate portions of main memory for AGP usage. The successor to Windows 95 (code-named Memphis) and Windows NT 5.0 will both support AGP. But until these OSs are available, a PC needs an OSR 2.1 patch to Windows 95, a driver from Intel, and the 440LX chip set, in order for Windows 95 to support AGP functionality fully. Certain AGP operating modes, however, will still work fine without the updates to Windows 95.

#### THE RENDERING PROCESS

AGP includes two basic modes of operation for rendering: local texturing (DMA mode) and AGP texturing (execute mode). Texture memory residing in system RAM is first copied through the AGP bus to the local frame buffer (on the graphics card), and then the texture data is read from the local frame buffer and operated on by the accelerator. Large sequential transfers often occur over the AGP bus using local texturing, as an entire texture bitmap must first be copied to the frame buffer before it is used.

AGP texturing is the key to enhancing performance when the local frame buffer is memory-constrained, or when multiple textures of various sizes are needed for 3-D rendering.

## Editors' Choice

- High-End PC: Micron Millennia XKU 300
- Workstation: Micron Powerdigm XSU



*The 300-MHz Pentium II represents an exciting, high-powered platform for leading-edge applications, whether you need a workstation or a PC. And yes, it's even affordable. On the high-end PC side, our Editors' Choice is the \$3,489 Micron Millennia XKU 300.*

In this fledgling group of AGP PCs, the Millennia was a standout performer on our 2-D tests and the top performer on our 3-D graphics and AGP tests. The Millennia's performance is attributable not only to its CPU but also to its 6.4GB IBM Ultra ATA hard disk and its 4MB Diamond Viper V330 AGP graphics board. Micron adds to this a Hitachi 12X/20X CD-ROM drive, an Iomega Zip drive, and a 56-Kbps-capable modem; with this configuration you're ready for some serious computing or 3-D gaming.

Our workstation Editors' Choice presented a difficult chal-

lenge because each of the three machines was exceptional in its own right. But the Micron Powerdigm XSU (\$6,204 with 3-D graphics, \$5,204 with 2-D) pulled away from the pack. This machine carries a significant architectural breakthrough: a 66-MHz PCI bus. Thanks to a Micron-designed Samurai chip set, the Powerdigm boasts a 66-MHz, 64-bit PCI slot as well as a highly efficient CPU-to-memory timing structure. These features paid off on our tests, on which the Powerdigm was clearly the top performer. We don't often see platform innovation such as this, but when we do, it's worthy of our highest honors.

competitors. The Bravo's Business Winstone 97 score was average; its CD-ROM WinMark 97 result, however, was this roundup's finest.

The unit's Business Disk WinMark 97 score fell right in line with scores produced by systems from Dell and NEC. But at 4.3GB, its Ultra DMA hard disk is

much smaller than others here. This hard disk, however, is encased in a noise-reducing plastic sleeve from Silent Systems—part of a System Noise Reduction scheme designed to make the Bravo significantly quieter than the average PC.

AST includes Intel's LANDesk 3.0, McAfee's VirusScan and WebScan,

IBM's VoiceType software, and audio applications with the machine. All in all, the Bravo is an admirable corporate solution.—Cade Metz

**Bravo MS 6300.** Street price: \$4,080. AST Computer, Irvine, CA; 800-876-4278, 714-727-4141; fax, 800-926-1278; [www.ast.com](http://www.ast.com). Circle 451 on reader service card.

AGP texturing treats system RAM as an extension of local frame-buffer memory, and allows only portions of single textures to be transferred across the AGP link and operated on by the graphics accelerator. There is no requirement to copy an entire texture bitmap to the local frame buffer first, and then read texture data from the frame buffer.

### PROTOCOLS AND PERFORMANCE

Aside from texturing modes, the AGP spec provides different protocol and performance options, which allow varied command and data throughput levels. Different graphics hardware subsystems will implement different levels of AGP protocols and features. AGP graphics subsystems actually use both PCI and AGP signaling protocols. For example, reads and writes to the graphics accelerator's registers or frame buffer from other devices will occur as PCI transactions, but reads and writes to system memory can occur using AGP transactions.

At the lowest level of protocol, called 1X mode, the AGP subsystem will operate as a 66-MHz PCI device for all transfers. A 2X mode permits an effective 133-MHz operation by sending data on both the rising and falling edges of the 66-MHz clock.

Optional features such as sideband addressing (SBA) allow more efficient bus utilization and better performance. SBA demultiplexes address and data requests, which allows simulta-

neous transfers of both commands and data. SBA transfers only occur from the graphics chip to the system chip set.

### OUR EXPERIENCE WITH AGP

Not all PCs and graphics adapters in this roundup were quite ready to use AGP texturing mode. However, the ATI 3D Rage Pro AGP card in the AST Bravo MS 6300 is capable of 2X AGP with pipelining, SBA, and AGP texturing. But when we tried to test the board with 4MB of memory (AST provided us with an 8MB board) to compare performance with a 4MB PCI version of the same card, the machine crashed while running our AGP test due to a memory parity error. We upgraded the BIOS on the ATI card and encountered the same problem. We suspect that the A2 stepping of the 440LX chip set in the Bravo may have contributed to the parity error (the most current version of the chip set is stepping A3).

We moved the ATI board to another system with an A3 stepping, and the test completed successfully; more important, it showed significant speedup compared with the PCI version of the card. The ATI PCI card performed at 1.85 fps (frames per second), but the ATI AGP card delivered 18.6 fps—quite an amazing improvement. We believe that by the time you read this, most of the early problems with AGP will have been worked out.



BENCHMARK TESTS

# 300-MHz Pentium II PCs



Whether the numbers were produced by a workstation or a high-end PC, our benchmark test results proved one thing: The 300-MHz Pentium II is ready for some serious action.

## What the Numbers Mean

The inclusion of both 300-MHz Pentium II high-end PCs and 300-MHz Pentium II workstations in this roundup required PC Magazine Labs to apply different test strategies for each grouping that would reflect expected usage scenarios. The five high-end PCs were each configured with 64MB of system RAM, Intel's new AGP-capable 440LX chip set, 4GB or larger Ultra DMA IDE hard disks with FAT16 partitions, and mainstream 2-D/3-D graphics cards with at least 4MB of memory. We ran our standard ZD Business Winstone 97, ZD Business WinBench 97, and ZD 3-D WinBench test suites under Microsoft Windows 95 on these systems. Systems were configured with either OSR 2.0 or OSR 2.1 versions of Windows 95. OSR 2.1 provides support for USB devices and system memory allocation for use with AGP texturing mode (see the sidebar "Introducing AGP"). Windows 95 systems using AGP texturing mode must also have the Intel-supplied VGARTD.VXD driver, which allows the 440LX chip set to communicate with Windows 95's memory management software, which in turn permits AGP memory allocation. (The upcoming Windows 98, code-named Memphis, and Windows NT 5.0 will have built-in support for AGP texturing mode).

All workstations were configured with 128MB of system RAM, Windows NT 4.0 with Service Pack 3, OpenGL-capable graphics cards with at least 16MB of memory, and 4GB (or larger) SCSI hard disks with NTFS partitions. We ran the ZD High-End Winstone 97 and ZD High-End WinBench 97 test suites on each system, as well as separate Pro/Engineer and AutoCAD tests. Our Pro/Engineer test delivers an overall result derived from running a trail file that creates and renders a mechanical fishing-reel device. It heavily stresses the OpenGL-capable high-end 3-D graphics cards (in addition to disk and CPU/memory subsystems), though it really doesn't benefit from

memory above 8MB on the graphics boards when running at our test resolution of 1,024-by-768 true color. Our AutoCAD test performs a variety of operations that exercise the disk, 2-D graphics, and CPU/memory subsystems. For detailed descriptions of each test, please visit our Web site ([www.pcmag.com](http://www.pcmag.com)), or refer to page 119 of our issue of June 10, 1997.

The high-end OpenGL graphics cards installed in the workstations are used for graphics-intensive 3-D application such as CAD, 3-D animation and rendering, VRML world modeling, and 3-D visualization. They are not necessarily stellar 2-D performers. The workstation vendors also provided us with standard 2-D/3-D graphics cards using 8MB of frame-buffer memory. We present results for both the high-end 3-D and standard 2-D/3-D cards for comparison. In general, the standard 2-D/3-D cards performed much better on the mostly 2-D-oriented High-End Winstone, High-End WinBench, and AutoCAD tests.

Ziff-Davis Benchmark Operation recently released a supplement to its 3D WinBench suite to exercise AGP implementations: A 3-D scene using approximately 5MB of textures (2.7 million texels at 2 bytes per texel). This scene is not included as part of the ZD 3D WinMark 97 score; it is presented as a separate score (ZD 3D WinMark 97 AGP). We ran this scene on all high-end PCs because they all had AGP graphics cards and Intel's 440LX chip set, which provides AGP support. Not all systems implement the same AGP bus protocols and texturing methods, which can affect performance on this special scene. All high-end PCs used graphics boards with 4MB of frame-buffer memory, except the AST Bravo MS 6300 and the NEC Direction SPL 300, which used 8MB boards.

We obtained many interesting results during testing because of the nature of the new technologies present in these systems. We found a few variations in AGP implementations exist among the tested units, and two different versions (or stepping levels) of the 440LX chip set (A2 and A3) among the tested systems. Intel claimed that there are no appreciable performance differences between the two steppings, so we accepted either stepping in our roundup. Intel maintains that all systems shipping to end users will contain the A3 stepping.

## Interpreting the Disk WinMark Scores

Intel's PIIX Bus Master IDE Driver for Windows 95 was used in the Gateway and Micron high-end PCs, and we've noted that it delivers

|                                | <b>ZD High-End<br/>Winstone 97</b><br>Score | <b>ZD High-End<br/>Graphics<br/>WinMark 97</b><br>Score | <b>ZD High-End Disk<br/>WinMark 97</b><br>Thousands of bytes/sec | <b>ZD CPUmark<sub>32</sub></b><br>Score | <b>ZD CD-ROM<br/>WinMark 97</b><br>Thousands of bytes/sec | <b>AutoCAD</b><br>Min:sec | <b>Pro/Engineer</b><br>Min:sec |
|--------------------------------|---------------------------------------------|---------------------------------------------------------|------------------------------------------------------------------|-----------------------------------------|-----------------------------------------------------------|---------------------------|--------------------------------|
| <b>STANDARD 2-D/3-D BOARDS</b> |                                             |                                                         |                                                                  |                                         |                                                           |                           |                                |
| Dell WorkStation 400           | 36                                          | 53                                                      | 2,620                                                            | 748                                     | 1,370                                                     | 1:57                      | 3:32                           |
| IBM IntelliStation M Pro       | 34                                          | 55                                                      | 3,620                                                            | 749                                     | 1,370                                                     | 1:57                      | 3:33                           |
| Micron Powerdigm XSU           | 41                                          | 54                                                      | 5,040                                                            | 811                                     | 1,760                                                     | 1:38                      | 2:33                           |
| <b>HIGH-END 3-D BOARDS</b>     |                                             |                                                         |                                                                  |                                         |                                                           |                           |                                |
| Dell WorkStation 400           | 35                                          | 36                                                      | 2,770                                                            | 748                                     | 1,350                                                     | 4:19                      | 2:47                           |
| IBM IntelliStation M Pro       | 32                                          | 32                                                      | 2,990                                                            | 749                                     | 1,370                                                     | 4:14                      | 2:47                           |
| Micron Powerdigm XSU           | 31                                          | 23                                                      | 4,700                                                            | 749                                     | 1,700                                                     | 2:01                      | 3:00                           |
|                                | BETTER ►                                    | BETTER ►                                                | BETTER ►                                                         | BETTER ►                                | BETTER ►                                                  | ◀ BETTER                  | ◀ BETTER                       |



|                          | <b>ZD Business Winstone 97</b><br>Score | <b>ZD Business Graphics WinMark 97</b><br>Score | <b>ZD Business Disk WinMark 97</b><br>Thousands of bytes/sec | <b>ZD 3D WinMark 97</b><br>Score | <b>ZD 3D WinMark 97 AGP</b><br>Score | <b>ZD CPUmark<sub>32</sub></b><br>Score | <b>ZD CD-ROM WinMark 97</b><br>Thousands of bytes/sec |
|--------------------------|-----------------------------------------|-------------------------------------------------|--------------------------------------------------------------|----------------------------------|--------------------------------------|-----------------------------------------|-------------------------------------------------------|
| <b>AST Bravo MS 6300</b> | <b>58</b>                               | <b>124</b>                                      | <b>1,240</b>                                                 | <b>144</b>                       | <b>19.2</b>                          | <b>746</b>                              | <b>1,560</b>                                          |
| Dell Dimension XPS D300  | 52                                      | 117                                             | 1,130                                                        | 244                              | 32.9                                 | 734                                     | 1,320                                                 |
| Gateway G6-300XL         | <b>64</b>                               | <b>127</b>                                      | <b>2,530</b>                                                 | 244                              | N/A                                  | 737                                     | 1,390                                                 |
| Micron Millennia XKU 300 | 59                                      | 130                                             | 2,390                                                        | <b>255</b>                       | <b>36.6</b>                          | 743                                     | 1,440                                                 |
| NEC Direction SPL 300    | 60                                      | <b>154</b>                                      | 1,290                                                        | 128                              | 14.4                                 | 744                                     | 1,370                                                 |
|                          | <b>BETTER ►</b>                         | <b>BETTER ►</b>                                 | <b>BETTER ►</b>                                              | <b>BETTER ►</b>                  | <b>BETTER ►</b>                      | <b>BETTER ►</b>                         | <b>BETTER ►</b>                                       |

N/A—Not applicable: The machine could not run this test.

extraordinarily good performance on our ZD Disk WinMark test, as well as noticable improvement on our ZD Winstone tests. The driver was developed by Intel to work optimally with its PIIX chip.

It appears that Intel's driver breaks down large disk read and write requests (such as 8K, 16K, 32K, and 64K) issued from an application program into smaller 4K blocks, and sets a flag on the requests to ensure that all 4K blocks are cacheable by Windows' disk cache. The driver will set a caching flag even if the application requested that the particular disk data *not* be cached. Our Winstone and WinBench test suites will request that certain data be cached, for proper operation. Intel's driver ignores our benchmark application's requests, and caches all the requests. Such behavior results in inflated benchmark test scores. In fact, Intel confirmed that there are no real-world performance differences between its driver and Microsoft's driver. We note that the Microsoft IDE driver seen in some of the reviewed systems does not have this sort of caching behavior, as it does not change the cachable status.

**ZD Business Winstone 97** On our Business Winstone tests, we witnessed a 20 percent gap in scores posted by the low-scoring Dell Dimension XPS D300 and the top-scoring Gateway G6-300XL, even though these machines appear to be configured identically (both use 8.4GB IBM Ultra DMA hard disks and 4MB STB Velocity 128 graphics cards with the nVidia Riva 128 engine). The difference in this case is the drivers: The Gateway machine used Intel's PIIX driver, which is responsible for doubling the system's Business Disk WinMark. This driver also boosts Winstone performance moderately. The Gateway and Dell units also use different driver versions for their STB graphics cards; the Gateway machine's Business Graphics WinMark score was 9 percent higher. Both these factors help to explain the G6's higher Winstone score.

**ZD Business Graphics WinMark 97** The top-scoring system on this test was the NEC Direction SPL 300, with the Number Nine Revolution 3D AGP board; second place went to the Micron Millennia XKU 300 and its Diamond Viper V330 AGP board. The Number Nine board's accelerator, called Ticket to Ride, provides users with a balanced combination of 2-D, 3-D, and video performance; its adeptness at running the Business Graphics WinMark test is not surprising, given that the test is 2-D-intensive, and other machines here used boards with graphics processors that are geared towards providing strong 3-D performance.

**ZD Business Disk WinMark 97** All of the PCs in this section of our roundup used hard disks from IBM's 5,400-rpm DeskStar Ultra DMA series (only disk capacities were different). Machines using Microsoft's IDE driver (those from AST, Dell, and NEC) all posted scores within 7 percent of each other. On the other side of the

fence were the Gateway and Micron systems, both of which produced astronomical Business Disk WinMark scores by using an Intel-supplied PIIX driver.

To examine performance further, we ran our Sequential Read Disk Inspection tests under WinBench at various block sizes. On these tests, systems with Microsoft's driver performed much better on sequential operations than systems with Intel's driver.

**ZD 3D WinMark 97** All of the high-end PCs here came equipped with AGP graphics cards. The scores that these machines generated are the highest we've seen to date. But keep in mind that a 3-D graphics card relies heavily on a system's CPU for floating-point calculations. The Pentium II processor is much more efficient on floating-point calculations than the Pentium; therefore, the 3D WinMark scores presented here should not be compared with scores reported in the graphics board roundup in our issue of June 24, 1997.

The star of the 3D WinMark show was the nVidia Riva 128 chip: Graphics cards based on this solution (the STB Velocity 128 3D AGP used by Dell and Gateway, and the Diamond Viper V330 AGP used by Micron) outscored all others by significant margins. There are a number of reasons for the Riva 128 chip's great 3-D performance, including an on-board 12K cache (internal to the graphics processor) that reduces latencies introduced by texture fetches from system memory.

**ZD 3D WinMark 97 AGP** Once again, machines running graphics cards based on the nVidia Riva 128 chip produced significantly higher scores than others. There is a 61 percent difference between the high-scoring Micron Millennia and the low-scoring NEC Direction. The AST Bravo's ATI Rage and the NEC Direction's Number Nine Revolution 3D graphics boards both had 8MB of on-board frame-buffer memory, compared with all others, which had only 4MB. The extra memory allowed these boards to contain all textures from our AGP test in the frame buffer (our test uses up to 5MB of textures). Therefore, in the AST and NEC machines, processing of these textures was left entirely to the graphics processor and local frame buffer.

The Gateway machine was unable to complete the AGP test, even with new drivers and an upgrade from OSR 2.0 to OSR 2.1 (the latter of which is required for full AGP support). The error we received indicated a problem accessing system memory. Since the Dell Dimension completed this test successfully, we believe that the Gateway system just wasn't ready for prime time.

#### **ZD High-End Winstone 97 and ZD High-End WinBench 97**

The combination of a 10,000-rpm Seagate Cheetah Ultra Wide SCSI hard disk, the new 3Dlabs Permedia 2-based Diamond Fire





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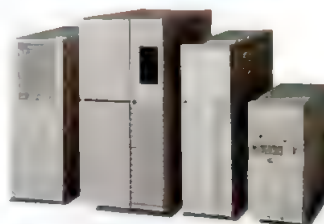
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## BENCHMARK TESTS

GL 1000 Pro graphics card, and Micron's new Samurai core-logic chip set with superior memory access speeds allowed the Micron Powerdigm XSU to excel on our High-End Winstone tests. The Dell WorkStation 400 and the IBM IntelliStation M Pro performed quite similarly across the board using their standard 2-D/3-D graphics cards. Both of these machines use ECC memory, which is more efficient with regard to data integrity but may slightly affect memory access timings.

We tested machines with their graphics boards set to true color (either 24-bit or 32-bit mode, depending on the board). During testing, we found—not surprisingly—that the standard 2-D/3-D boards generally performed better than the high-end 3-D boards on our mostly 2-D based tests (including High-End Winstone and ZD High-End Graphics WinMark 97).

**AutoCAD and Pro/Engineer** In general, AutoCAD scores generated by workstations equipped with 2-D/3-D graphics boards were much higher than scores produced with 3-D cards installed, because AutoCAD is essentially a 2-D application. The 2-D/3-D Matrox Millennium II (used by Dell and IBM) and the

Diamond Fire GL 1000 Pro (used by Micron); as well as the Diamond Fire GL 4000 (used by Micron for 3-D) were assisted by enhanced AutoCAD display-list drivers. The Micron Powerdigm posted top scores on our AutoCAD test thanks to its graphics board, its 10,000-rpm Seagate Cheetah hard disk, and its exceptional CPU-to-memory subsystem.

Our Pro/Engineer test exercised the OpenGL capabilities of each machine's graphics board. The Matrox Millennium II currently is not a certified OpenGL accelerator for Pro/Engineer; therefore all OpenGL graphics calls are rendered in software. The Millennium II-equipped Dell and IBM systems performed significantly slower than the Micron machine, a testament to the OpenGL capabilities of the Diamond Fire GL 1000 Pro card and its 64-bit/66-MHz PCI interface. But Micron's performance was also assisted by its fast Cheetah hard disk. The Dell and IBM units, using the high-speed Elsa and Intergraph cards, respectively, exceeded Micron's performance with the Diamond Fire GL 4000. Most surprising, Micron's standard 2-D/3-D board outperformed its high-end 3-D board in Pro/Engineer.—*Analysis written by Laura Cox and Nick Stam*

### Dell Dimension XPS D300

The Dimension XPS D300 (\$3,299 direct), from Dell Computer Corp., gives mainstream power users plenty to rave about. This machine differentiates itself from the other systems in this roundup with its combination of big peripherals and a relatively small price. This ATX mini-tower also delivers on performance, particularly with 3-D.

The Dimension's STB Velocity 128 3D AGP graphics card, based on nVidia's Riva 128 chip set, plugs into an AGP slot situated just above three open PCI slots, a shared slot occupied by a Creative Labs AWE64 wave-table audio card, and an ISA slot occupied by a U.S. Robotics 56-Kbps modem.

With the help of the STB card, the Dimension posted big scores on our 3D WinMark and 3D WinMark AGP tests. On our Business Winstone 97 and Business Graphics WinMark 97 tests, the unit's scores were lower than the competition's, but not by a margin that would be readily discernible to an end user. On our

Business Disk WinMark 97 test, using an 8.4GB Ultra DMA hard disk, the unit posted a score right in line with those turned in by the AST and NEC systems, the other two machines in this roundup without Intel's PIIX driver.

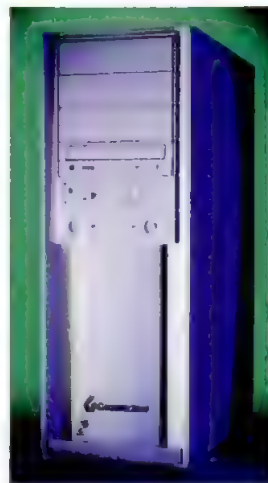
The Dimension ships with Altec Lansing speakers and subwoofer, a 17-inch monitor, and a choice of Microsoft Office 97 Small Business Edition or Microsoft Home Essentials with Best of Entertainment Pack.

For those looking for a well-stocked, affordable PC, the Dimension delivers.—*CM*

**Dimension XPS D300.** Direct price: \$3,299. Dell Computer Corp., Round Rock, TX; 800-388-8542, 512-338-4400; fax, 512-728-3653; [www.dell.com](http://www.dell.com). *Circle 452 on reader service card.*

### Gateway G6-300XL

Though a rangy tower chassis gives the Gateway G6-300XL (\$3,799 direct) a unique look, this machine is very similar to the Dell Dimension XPS D300. The



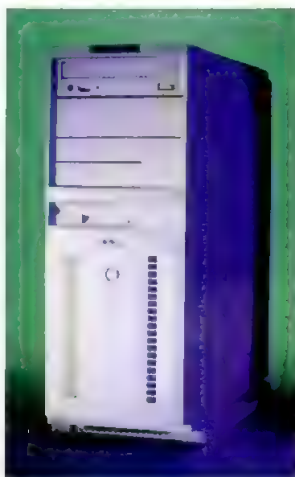
Gateway's tower chassis has plenty of expansion space.

two systems use the same Intel Atlanta motherboard, 440LX chip set, 8.4GB IBM Ultra DMA hard disk, and STB Velocity 128 3D AGP card. Nevertheless, the G6 was a slightly better performer—a distinction attributable mainly to its disk driver.

The G6, in fact, was the leading Business Winstone 97 performer here, primarily due to disk performance that was about 5 percent higher than that of its closest competitor, the Micron Millenniuma XKU, and more than double that of the rest. Its Business Graphics WinMark 97 score was on the same tier as the nVidia-based systems from Dell and Micron.

Yet testing also proved that the system's STB board is still a work in progress. Changing resolution on the fly resulted in an unreadable display, a problem that Gateway says it will correct by the time the G6 ships. The machine also was unable to run our 3D WinMark AGP test, although its 3D WinMark score was at the top of the pack.

Outside of performance, the G6's advantage is expandability. The G6 tower offers four external 5.25-inch drive bays



Dell's Dimension gives power users lots to rave about.



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To make it easier for you to experience x2 now, we're introducing "x2 Delivers More," a special program that will show you why buying an x2 modem now makes so much sense.



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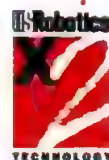
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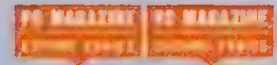




**SUMMARY OF FEATURES**

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# 300-MHz Pentium II Machines



■ YES ■ NO □ OPTIONAL

Products listed in alphabetical order

|                                                 | AST Bravo MS 6300              | Dell Dimension XPS D300          | Dell WorkStation 400                                                      | Gateway G6-300XL               | IBM Intelli-station M Pro                                                 | Micron Millennia XKU 300         | Micron Powerdigm XSU                                                      | NEC Direction SPL 300          |
|-------------------------------------------------|--------------------------------|----------------------------------|---------------------------------------------------------------------------|--------------------------------|---------------------------------------------------------------------------|----------------------------------|---------------------------------------------------------------------------|--------------------------------|
| Type of system                                  | High-end PC                    | High-end PC                      | Workstation                                                               | High-end PC                    | Workstation                                                               | High-end PC                      | Workstation                                                               | High-end PC                    |
| Price (monitor not included for workstations)   | \$4,080 (street)               | \$3,299 (direct)                 | With 3-D graphics card, \$5,878, with 2-D graphics card, \$4,878 (direct) | \$3,799 (direct)               | With 3-D graphics card, \$7,500, with 2-D graphics card, \$4,200 (street) | \$3,489 (direct)                 | With 3-D graphics card, \$6,204, with 2-D graphics card, \$5,204 (direct) | \$3,330 (direct)               |
| Installed RAM and type                          | 64MB SDRAM                     | 64MB SDRAM                       | 128MB EDO ECC DRAM                                                        | 64MB SDRAM                     | 128MB EDO ECC DRAM                                                        | 64MB SDRAM                       | 128MB SDRAM                                                               | 64MB SDRAM                     |
| Hard disk                                       | IBM DHEA-34330                 | IBM DHEA-38451                   | Seagate Barracuda ST34371W                                                | IBM DHEA-38451                 | IBM DCHS-34550                                                            | IBM DHEA-36480                   | Seagate Cheetah ST34501W                                                  | IBM DHEA-36480                 |
| Capacity and interface                          | 4.3GB Ultra DMA                | 8.4GB Ultra DMA                  | 4.4GB Ultra Wide SCSI                                                     | 8.4GB Ultra DMA                | 4.3GB Ultra Wide SCSI                                                     | 6.4GB Ultra DMA                  | 4.3GB Ultra Wide SCSI                                                     | 6.4GB Ultra DMA                |
| Graphics adapter                                | ATI 3D Rage II Pro AGP         | STB Velocity 128 3D AGP          | Dell WorkStation 3D Graphics Board (Elsa Gloria-L/MX PCI)                 | STB Velocity 128 3D AGP        | Intergraph Intense 3D Pro 1000/T PCI                                      | Diamond Viper V330 AGP           | Diamond Fire GL 4000 33-MHz PCI                                           | Number Nine Revolution 3D AGP  |
| Graphics chip set                               | ATI 3D Rage Pro AGP-133        | nVidia Riva 128                  | 3DLabs Glint Delta R1 + Glint MXR1                                        | nVidia Riva 128                | S3 Trio 64V.2 2DX                                                         | nVidia Riva 128                  | Mitsubishi 3D Pro/2MP                                                     | Ticket to Ride                 |
| Graphics memory                                 | 8MB SGRAM                      | 4MB SGRAM                        | 8MB VRAM, 8MB EDO DRAM                                                    | 4MB SGRAM                      | 16MB SDRAM, 4MB SGRAM                                                     | 4MB SGRAM                        | 15MB 3DRAM, 16MB CDRAM                                                    | 8MB WRAM                       |
| 2-D graphics adapter/memory (workstations only) | N/A*                           | N/A*                             | Matrox Millennium II/ 8MB WRAM                                            | N/A*                           | Matrox Millennium II/ 8MB VRAM                                            | N/A*                             | Diamond Fire GL 1000 66-MHz PCI Pro / 8MB SGRAM                           | N/A*                           |
| Monitor                                         | ASTVision 7U                   | Dell 1000LS                      | Dell 1000HS Trinitron                                                     | MAG InnoVision EV900           | IBM G72                                                                   | Micron 700FGx                    | Hitachi CM801MU                                                           | NEC TX-D7F35NM                 |
| Measured diagonal size (inches)                 | 15.8                           | 15.9                             | 15.7                                                                      | 18.0                           | 15.5                                                                      | 16.0                             | 20.0                                                                      | 16.0                           |
| Price (workstations only)                       | N/A**                          | N/A**                            | \$749 (direct)                                                            | N/A**                          | \$670 (street)                                                            | N/A**                            | \$850 (direct)                                                            | N/A**                          |
| <b>Multimedia Features</b>                      |                                |                                  |                                                                           |                                |                                                                           |                                  |                                                                           |                                |
| CD-ROM drive (speed)                            | Toshiba XM-6102B (12X/24X)     | NEC CDR 288 (12X/24X)            | NEC CDR-1800A (12X/24X)                                                   | Toshiba XM-6102B (12X/24X)     | Sony 76H6107 (16X)                                                        | Hitachi CDR-8330 (12X/20X)       | Plextor PX-20TS (12X/20X)                                                 | Goldstar CRD 8240B (24X)       |
| Sound adapter                                   | ESS 1869 (integrated)          | Creative Labs SoundBlaster AWE64 | Crystal Wave CS4236B (integrated)                                         | Ensoniq AudioPCI               | Crystal Wave CS4236B (integrated)                                         | Creative Labs SoundBlaster AWE64 | Creative Labs SoundBlaster AWE64                                          | Yamaha OPL3 (integrated)       |
| <b>Motherboard Components</b>                   |                                |                                  |                                                                           |                                |                                                                           |                                  |                                                                           |                                |
| Motherboard manufacturer                        | Intel                          | Intel                            | Dell                                                                      | Intel                          | Intel                                                                     | Intel                            | Micron                                                                    | Intel                          |
| Chip set                                        | Intel 440LX                    | Intel 440LX                      | Intel 440FX                                                               | Intel 440LX                    | Intel 440FX                                                               | Intel 440LX                      | Micron Samurai                                                            | Intel 440LX                    |
| Multiprocessor socket                           | ■                              | ■                                | ■                                                                         | ■                              | ■                                                                         | ■                                | ■                                                                         | ■                              |
| Maximum RAM                                     | 384MB                          | 384MB                            | 512MB                                                                     | 384MB                          | 512MB                                                                     | 384MB                            | 1GB                                                                       | 384MB                          |
| Expansion-bus slots                             | 1 AGP, 1 ISA, 2 PCI, 1 PCI/ISA | 1 AGP, 1 ISA, 3 PCI, 1 PCI/ISA   | 3 PCI, 2 PCI/ISA                                                          | 1 AGP, 1 ISA, 3 PCI, 1 PCI/ISA | 1 ISA, 3 PCI/ISA                                                          | 1 AGP, 1 ISA, 3 PCI, 1 PCI/ISA   | 1 ISA, 1 66-MHz PCI, 2 PCI, 1 PCI/ISA                                     | 1 AGP, 1 ISA, 3 PCI, 1 PCI/ISA |
| Front-accessible drive bays (5.25" / 3.5")      | 3 / 1                          | 2 / 3                            | 2 / 1                                                                     | 4 / 1                          | 2 / 1                                                                     | 2 / 3                            | 2 / 3                                                                     | 2 / 2                          |
| Internal drive bays (5.25" / 3.5")              | 0 / 1                          | 0 / 2                            | 0 / 2                                                                     | 0 / 6                          | 0 / 2                                                                     | 0 / 2                            | 0 / 2                                                                     | 0 / 2                          |
| Power-supply wattage                            | 200W                           | 200W                             | 230W                                                                      | 200W                           | 200W                                                                      | 235W                             | 235W                                                                      | 235W                           |
| USB connectors                                  | ■                              | ■                                | ■                                                                         | ■                              | ■                                                                         | ■                                | ■                                                                         | ■                              |
| <b>Service and Support</b>                      |                                |                                  |                                                                           |                                |                                                                           |                                  |                                                                           |                                |
| 24-hour, 7-day live technical support           | ■                              | ■                                | ■                                                                         | ■                              | ■                                                                         | ■                                | ■                                                                         | ■                              |
| Standard warranty on parts/labor                | 3 years/3 years                | 3 years/1 year                   | 3 years/3 years                                                           | 3 years/3 years                | 3 years/1 year                                                            | 3 years/3 years                  | 3 years/3 years                                                           | 3 years/3 years                |
| 24-hour turnaround for parts replacement        | ■                              | ■                                | ■                                                                         | ■                              | □                                                                         | ■                                | ■                                                                         | ■                              |

N/A\*—Not applicable. The product does not have this feature. N/A\*\*—Not applicable. The monitor is included in the system's price.

(one used by a 12/24X Toshiba CD-ROM drive), six internal 3.5-inch bays (one used by the unit's hard disk), two open PCI slots, and an open shared slot. One PCI slot is used for an Ensoniq audio card, and a lone ISA slot is used for a Telepath 56-Kbps-capable modem.

Gateway also provides a 19-inch Mag InnoVision monitor and couples the Ensoniq audio card with a Boston Acoustics Micromedia speaker set. The machine's

software bundle includes Microsoft Office 97 Small Business Edition and several MMX titles.

The G6 should be a great multimedia machine once its graphics issues are resolved.—*CM*

**Gateway G6-300XL.** Direct price: \$3,799. Gateway 2000 Inc., North Sioux City, SD; 800-846-2000, 605-232-2000; fax, 605-232-2023; [www.gw2k.com](http://www.gw2k.com). *Circle 453 on reader service card.*

## Micron Millennia XKU 300



If you're excited by the potential of AGP-powered graphics and want a fast PC that delivers top-notch 3-D performance, Micron has a great offering in the Millennia XKU 300 (\$3,489 direct). While this machine was a standout performer on our 2-D tests, it topped the





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competition on our 3-D tests.

The Millennia came equipped with a capacious 6.4GB IBM Ultra DMA hard disk and a 4MB Diamond Viper V330 AGP graphics board powered by the nVidia Riva 128 accelerator. With the aid of Intel's PIIX bus-mastering IDE driver, the Millennia produced a huge Business Disk WinMark 97 score; the system's Business Winstone 97 and Business Graphics WinMark 97 scores were also highly competitive. Its CD-ROM WinMark 97 performance, which is dependent on a 24X Hitachi CD-ROM, was second only to that of the AST unit.

The real story behind this PC, however, is 3-D. The Millennia's scores on our 3D WinMark and 3D WinMark AGP tests were the best in this roundup. We also found in the course of testing that the machine was the most stable of this fledgling group.

A great add-on to the Millennia is Micron's Fusion 3D Bundle—a multimedia upgrade consisting of a DVD drive, AWE64 sound, Cambridge SoundWorks speakers, a subwoofer, a Direct3D game bundle, and a Microsoft SideWinder joystick (\$649 direct).

The Millennia uses its shared expansion slot for an audio card and its ISA slot for a 56-Kbps-capable modem, and leaves its three PCI slots open. It also has an Iomega Zip drive in one of its front 3.5-inch drive bays. This leaves one external 3.5-inch bay, one external 5.25-inch bay, and one internal 3.5-inch bay available for expansion.

Micron also ships the Millennia with a 17-inch Micron 700FGx monitor, two small Advent speakers, and Microsoft Office Small Business Edition.

Power users with a yen for great 3-D will love the Millennia, the most consistent performer in our LX roundup.—*CM*  
**Millennia XKU 300.** Direct price: \$3,489. Micron Electronics Inc., Nampa, ID; 888-

634-8799, 208-893-3343; fax, 208-893-3424; [www.micronpc.com](http://www.micronpc.com). Circle 455 on reader service card.

### NEC Direction SPL 300

NEC Computer Systems Division's new direct-sales PC line is led by the NEC Direction SPL 300 (\$3,330 direct). This 300-MHz Pentium II-based minitower, with Intel motherboard and 440LX chip set, includes a 6.4GB hard disk, a Number Nine Revolution 3D graphics card with 8MB of WRAM, and a 17-inch NEC monitor. Geared toward knowledge users, power users, the small/home-office market, and small businesses, the Direction is a great value for anyone interested in getting the latest technologies without paying a premium price.

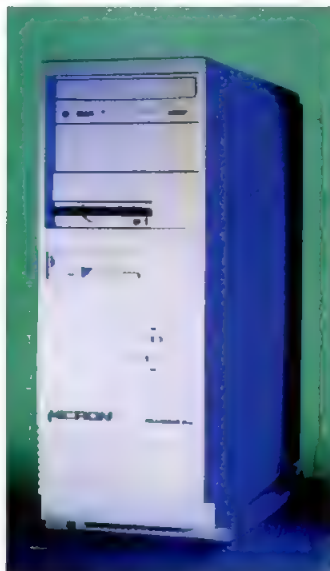
In our testing, the Direction performed extremely well under 2-D-intensive tasks, leading the pack on the Business Graphics WinMark 97 test, and placing second to Gateway's entry on our Business Winstone 97 test. On our Business Disk WinMark 97 test, its scores were on a par with the other machines here that don't use Intel's disk driver.

On our 3-D tests, however,

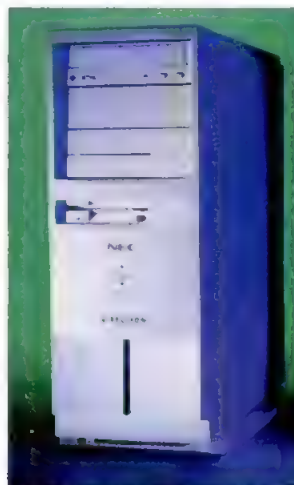
the machine lagged well behind top performers Dell, Gateway, and Micron, all of which used graphics boards based on nVidia's Riva 128 engine. We suspect that this difference in scores is due to the Number Nine board's graphics processor, called Ticket to Ride. Because this accelerator was designed and built by Number Nine to offer the end user the best combination of 2-D, 3-D, and video performance, it was outrun by 3-D-specific processors on other graphics boards when executing 3-D-specific tasks.

Our test machine was also equipped with a 24X Goldstar CD-ROM drive and Altec Lansing ACS90 speakers on the hardware side, and Microsoft Office 97 Small Business Edition on the software side. The Direction is backed by a generous warranty, which includes parts and labor for three years, as well as on-site service for the first year.

An early entry into the highest level of desktop computing, the Direction presents an attractive combination of big-name features and impressive performance at a great price.—*Bruce Brown*  
**NEC Direction SPL 300.** Direct price: \$3,330. NEC Computer Systems Division, Mountain View, CA; 888-863-2669; [www.neccomputers.com](http://www.neccomputers.com). Circle 454 on reader service card.



Micron's Millennia is an awesome machine for 3-D graphics.



NEC's Direction was a stellar 2-D-graphics performer.

### 300 MHz Pentium II

## Workstations

### Dell WorkStation 400

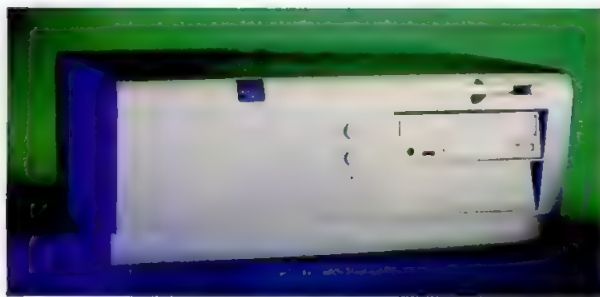
Dell Computer Corp. has hit the ground running with the Dell WorkStation 400, its debut machine in this market. The vendor expects most to be purchased by corporations and is targeting mechanical CAD, EDA, financial trading and modeling, and software engineering applications. At direct prices of \$4,878 with a 2-D graphics card, and \$5,878 with a 3-D graphics card,

you may just want to stock up.

The WorkStation 400 showcases Dell's own dual-CPU motherboard with the 440FX chip set, EDO ECC memory, and a 4.4GB Ultra Wide SCSI hard disk. The system has two USB ports and integrated 3Com 10/100-Mbps Ethernet circuitry. This machine is also DMI 2.0-compliant and includes Dell's software package Inspector for managing system assets.

Dell's 3-D graphics solution is a 16MB

COVER STORY  
300-MHz Pentium II PCs



The DMI 2.0-compliant Dell Workstation is a powerful asset to the corporate LAN.

Elsa GLoria-L/MX, which is powered by the Glint/MX accelerator. With this board, the WorkStation 400 bettered its competition on our High-End Winstone 97 test and also posted a great score on the Pro/Engineer measure. For 2-D graphics, Dell's board of choice is the Matrox Millennium II with 8MB of WRAM. The system achieved very competitive scores with this card across all tests.

With an attractive mix of price, features, and performance, the WorkStation 400 should find a ready market with established Dell customers, and will definitely attract

the attention of other buyers for both 2-D and 3-D applications.—BB

**Dell WorkStation 400.** Direct price: With 2-D graphics card, \$4,878; with 3-D graphics card, \$5,878. Dell Computer Corp., Round Rock, TX; 800-289-3355, 512-338-4400; [www.dell.com](http://www.dell.com). Circle 452 on reader service card.

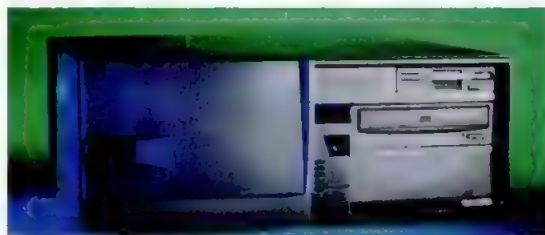
### IBM IntelliStation M Pro

IBM PC Co.'s resources in enterprise and large-systems computing are evident in the single-CPU IBM IntelliStation M Pro (\$4,200 street, with a 2-D graphics card; \$7,500, with a 3-D graphics card). The system targets commercial customers for mechanical and E-CAD, software development, and financial services applications. Performance and mission-critical features make the IntelliStation attractive for vital operations, even though the system can accommodate

only one processor and not two.

This machine came equipped with ECC EDO RAM, as well as a 4.3GB IBM Ultra Wide SCSI hard disk. The IntelliStation integrates Fast Ethernet with Wake-on-LAN technology, allowing remote management even when turned off. The system also features IBM's Asset Care: 22-digit serial numbers are etched on major components, and the numbers are registered with Retaina Group, a third-party security firm that assists in the retrieval of stolen assets.

Using a Matrox Millennium II graphics board, the IBM unit posted fairly competitive scores on our 2-D tests. Its performance highlight was a first-place High-End Graphics WinMark 97 result. For 3-D test-



With Wake-on-LAN technology, IBM's IntelliStation can be managed even when the power is turned off.



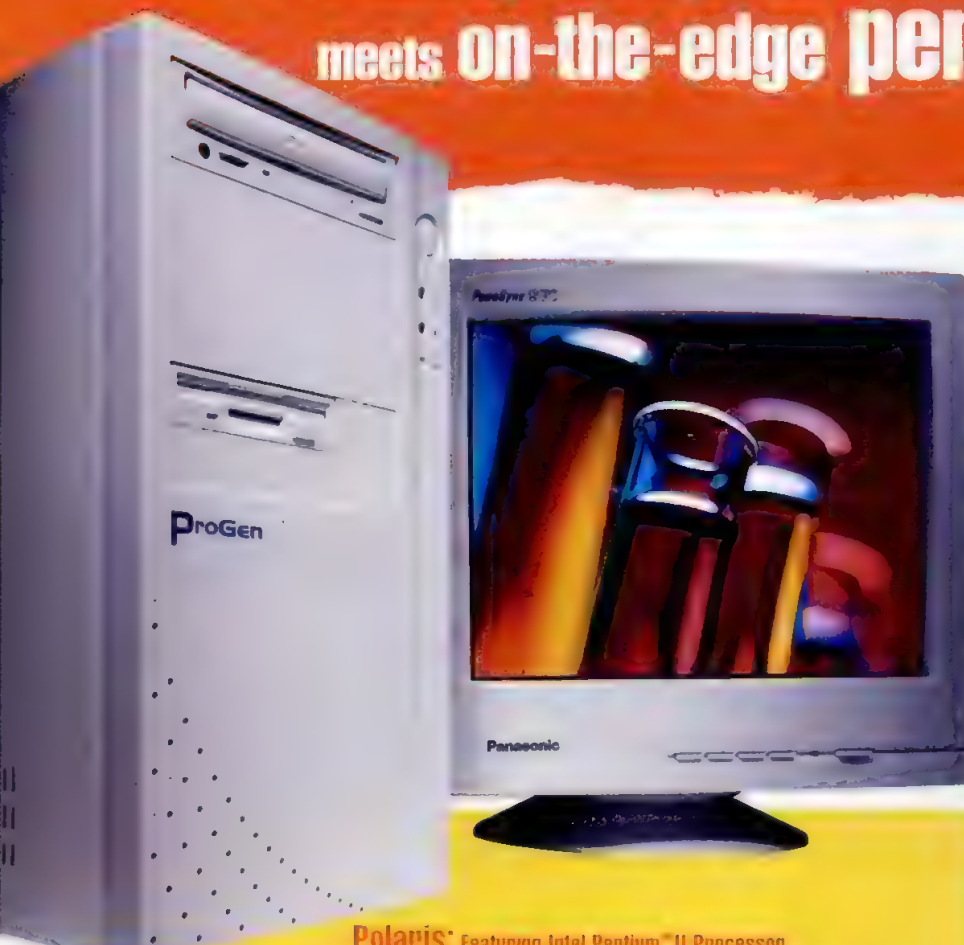
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COVER STORY  
300-MHz Pentium II PCs

ing, IBM equipped the system with an Intergraph Intense 3D Pro 1000/T board with 20MB of memory. The system's scores on all of these tests kept pace with the others. The IntelliStation's Pro/Engineer timing was particularly impressive.

Data integrity, system security, and the ability to reside smartly on a LAN are the IntelliStation's top advantages, features that should endear it to corporations.—**BB**  
**IBM IntelliStation M Pro.** Street price: With 2-D graphics card, \$4,200; with 3-D graphics card, \$7,500. IBM PC Co., Somers, NY; 800-426-2968; faxback, 800-426-3395; [www.pc.ibm.com/intellistation](http://www.pc.ibm.com/intellistation). Circle 457 on reader service card.

### Micron Powerdigm XSU

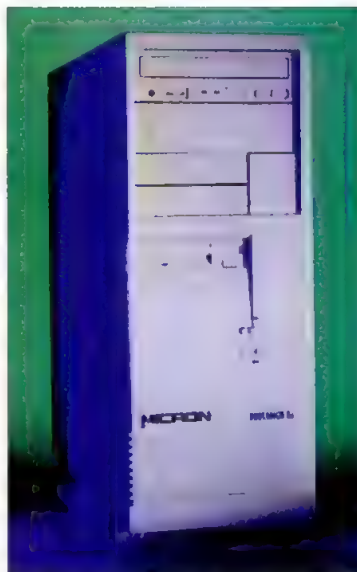


The most exciting and innovative machine in this roundup is our Editors' Choice in the workstation category, the Powerdigm XSU, from Micron Electronics (\$5,204 direct, with a 2-D graphics card; \$6,204, with a 3-D graphics card). What sets it apart is its 66-

MHz PCI bus support, courtesy of Micron's Samurai chip set.

In designing the Powerdigm, Micron wanted to equip the workstation with extra I/O by adding a second PCI bus. But the company didn't wish to use a hierarchical bus structure, which limits system bandwidth by funneling data through the top-level bus. Instead, Micron developed the Samurai chip set and set up a peer-level PCI bus structure. The chip set's two PCI buses operate separately, and the second offers 66-MHz, 64-bit performance.

During 2-D benchmark testing, we tested the Powerdigm with an 8MB Diamond Fire GL 1000 Pro board plugged into the 66-MHz PCI slot. With this card—and a 4.3GB 10,000-rpm Ultra Wide SCSI hard disk—the machine



Micron's Powerdigm brings 66-MHz PCI to the workstation platform.

cleaned up, garnering the best score on every test except High-End Graphics WinMark 97. With its Diamond Fire GL 4000 3-D board installed, the Powerdigm was the top scorer on half the tests. The system's AutoCAD timing was awesome—half that of its competition's scores.

Micron's Powerdigm XSU is the workstation to beat.—**CM**

**Powerdigm XSU.** Direct price: With 2-D graphics card, \$5,204; with 3-D graphics card, \$6,204. Micron Electronics Inc., Nampa, ID; 888-634-8799, 208-893-3343; fax, 208-893-3424; [www.micronpc.com](http://www.micronpc.com). Circle 455 on reader service card. **PC**

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PCs

# THE BEST C/P

For

**PC Magazine Labs puts 12 of today's leading x86 processors through benchmark and application tests to help you select the best processor. *By Michael Slater***

NEVER BEFORE HAVE PC BUYERS BEEN FACED WITH SO many microprocessor choices. Alternatives to Intel's Pentium, Pentium MMX, Pentium Pro, and Pentium II processors are now available in AMD's K5 and K6, as well as Cyrix's MediaGX, 6x86, and 6x86MX. Counting all the clock speeds, you have more than two dozen choices.

Intel's competitors have to price their chips significantly below Intel's to generate interest, and this often makes them very good values. Competition increases the pres-

sure on Intel to cut its own prices, leading to lower prices all around. The range of processors lets you choose the price/performance ratio that suits you best.

There are many pitfalls in choosing the best processor, however. The vendors' positioning of these CPUs doesn't tell the full story, since performance varies considerably from one application type to another—you need to look at a variety of test results, and think about what kinds of applications are important to you. In this article, we look at

**5/00** Combination of Intel 486 and Windows 3.0 revolutionizes business desktops, bringing a GUI interface to PCs.



## Processor Timeline

From the heady days of Windows 3.0, 486s, and 25 MHz, we now look to Windows NT and Pentium IIs at speeds of 300 MHz.

Compiled by Nancy Hirsch and Josh Levy

**1989 April**  
**Intel 486DX, 25 MHz**

165-mm<sup>2</sup> die, 1.2 million transistors  
First truly pipelined x86; has 8K of L1 cache and a math coprocessor

**May**  
**Windows 3.0**  
Windows' first commercial success.

**1990 September**  
**Motorola 68040; 20, 33 MHz**  
153-mm<sup>2</sup> die, 1.2 million transistors

Upgrades 68030 architecture, has a memory management unit and FPU.

**1991 September**  
**Intel 486SX, 16 MHz**

316-mm<sup>2</sup> die, 1,185,000 transistors  
Lower-cost 486 without the FPU; still has a 32-bit bus interface.

**1992 February**  
**DEC Alpha 21064, 150 MHz**  
234-mm<sup>2</sup> die, 1.7 million transistors  
Superscalar and superpipelined 64-bit architecture; has a very high clock rate

(150 is quickly revved to 200).

**March**  
**Intel 486DX2, 50 MHz**

230-mm<sup>2</sup> die, 1.2 million transistors  
First x86 chip with external bus running at half the core speed.

**OS/2 2.0**

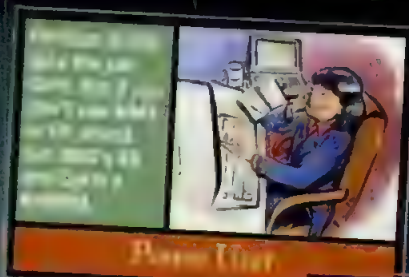
**April**  
**Windows 3.1**

**May**  
**Cyrix 486SLC, 25 MHz**  
108-mm<sup>2</sup> die, 600,000 transistors

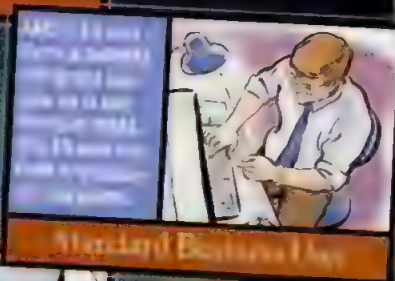
## What Kind of User Are You?

Although the Pentium II is the performance leader across our tests, it isn't always the most cost-effective solution. The applications you run most often determine the best processor for you.

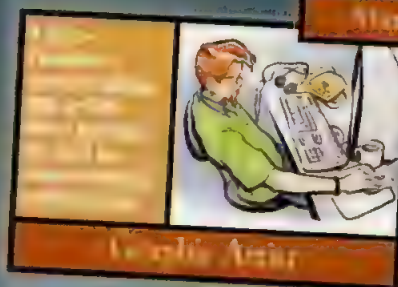
# U Your Next PC



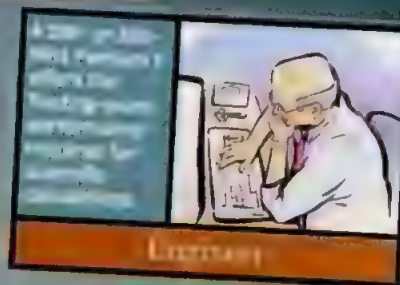
Phone User



Standard Business User



Graphic Artist



Lawyer

each of today's PC processors and explain how they compare in technology, performance, and future prospects.

When comparing processor performance, it is important that the test machines' hardware subsystems be consistent. All too often, systems are compared in which many factors differ, leading to incorrect conclusions. Here we present the results of benchmark tests run on carefully chosen systems with the same amounts and types of mem-

ory, graphics cards, and hard disks, providing a more objective evaluation of processor performance. We also ran 3-D, floating-point, and MMX tests to give you the full performance picture.

### SELECTING YOUR PROCESSOR

To make the best processor selection, you need to decide what kinds of applications are important to you. If traditional business applications are your focus and you're looking for rock-bottom prices, the non-MMX chips (the Pen-

**4/93** PowerPC revitalizes the Mac platform, providing more speed and processing power to graphic artists.



Has a 486-type core with a 386SX bus interface; lacks on-chip FPU.

**1993 March**  
**Intel Pentium, 60 MHz**

294-mm<sup>2</sup> die, 3.1 million transistors  
First dual-pipelined superscalar x86, borrows RISC techniques.

**April**  
**AMD 486, 33 MHz**

89-mm<sup>2</sup> die, 1 million transistors  
**PowerPC 601; 50, 66 MHz**

120-mm<sup>2</sup> die, 2.8 million transistors  
Revives Macintosh line; a hybrid design that borrows bus logic from Motorola's 88100 RISC chip; intended to run Mac OS, OS/2, and Windows NT.

**October**  
**PowerPC 603; 66, 80 MHz**

83-mm<sup>2</sup> die, 1.6 million transistors  
First true PowerPC architecture; meant for use in portables.

**December**  
**Cyrix 486DX, 33 MHz**

196-mm<sup>2</sup> die, 1.1 million transistors

**1994 March**  
**Intel 486DX4; 75, 100 MHz**

87-mm<sup>2</sup> die, 1.6 million transistors  
Clock-tripled core (bus runs at 25 or 33 MHz); includes 16K of L1 cache; first 486 to run at 3.3V internally.

**April**  
**PowerPC 604, 100 MHz**

197-mm<sup>2</sup> die, 3.6 million transistors  
**Motorola 68060; 40, 66 MHz**

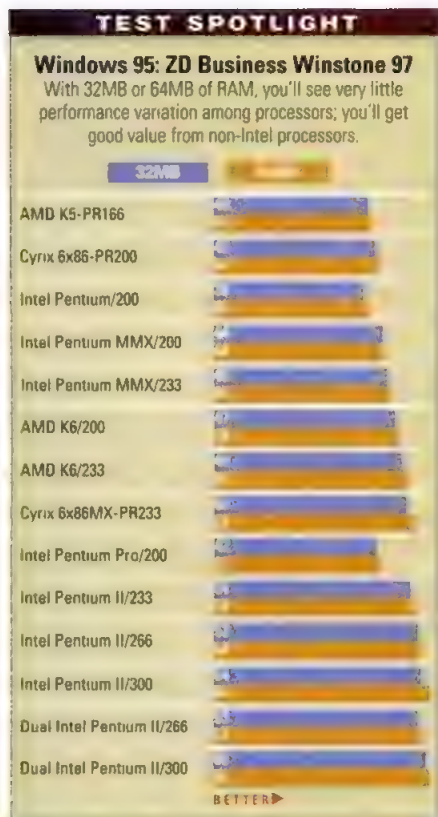
217-mm<sup>2</sup> die, 2.5 million transistors  
Dual-pipelined 68000-family processor;

meant to be a Pentium competitor, but does not gain mainstream market acceptance.

**September**  
**DEC Alpha 21164; 266, 300 MHz**  
314-mm<sup>2</sup> die, 9.3 million transistors  
**NexGen Nx586, 70 MHz (PR75)**

118-mm<sup>2</sup> die, 3.5 million transistors  
MHz no longer tells the story. The P-rating, or PR-rating, uses performance on our Winstone test to position the chip, a PR75 means this chip performs on a par with a Pentium/75





tium, K5, 6x86, and Pentium Pro) all offer good value. These chips will quickly disappear from the market, however. Cyrix has already stopped making the 6x86, though you may see such systems being sold from inventory for a few months, and AMD is following suit with the K5. The Pentium Pro is a reasonable choice for business PC buyers who use Windows NT (it suffers under Windows 95) and don't care about MMX, but it is being rapidly pushed out by the Pentium II at the high end and a raft of alternatives below it (see chart, right).

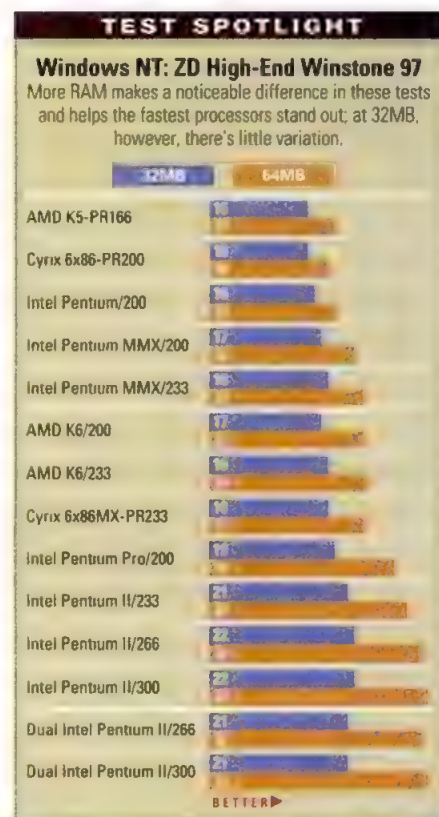
Even though relatively few users today benefit much if at all

from MMX, the newer MMX CPUs incorporate a variety of other enhancements that enable them to deliver higher performance on *all* applications. So if performance is important to you, the MMX CPUs are the ones to focus on even if you don't care about MMX. By the end of this year, the price premium for MMX CPUs will all but disappear, making non-MMX chips irrelevant.

If you primarily use typical business applications like those represented in the Business Winstone program, but don't want to miss out on the potential of MMX, the AMD K6 and the Cyrix 6x86MX provide great value. They are as fast as or faster than Intel's Pentium MMX on business applications, and they are less expensive (see chart, left). Their MMX performance isn't stellar, but it is better than not having MMX at all. The Pentium II is faster than any of the competition on nearly any application, but it isn't likely to make much difference on typical business applications—and its price/performance ratio is much worse than those of the AMD and Cyrix processors.

If games are important to you, watch 3-D performance. The K6 and 6x86MX CPUs do poorly when they depend on software emulation for 3-D functions (see chart, next page), so you don't want to couple these chips with a low-end graphics card. With a high-end 3-D card, the net 3-D performance gap between Intel's CPUs and the alternatives narrows, but even the Pentium MMX delivers better 3-D performance than either the K6 or the 6x86MX—and the Pentium II is significantly faster.

With a good 3-D card, a 200-MHz Pentium Pro comes close to the 3-D performance of a Pentium II/233, and its price is a bargain. But once you've gone this far, you



might as well get the MMX capability of the Pentium II—not for 3-D, but for image editing and other applications, as well as its superior performance under Windows 95.

If you care about image-editing performance with programs such as Adobe Photoshop and PhotoDeluxe, avoid the Intel alternatives and buy the fastest Intel processor you can afford. Graphics accelerators don't help with image manipulation. Photoshop is one program where a dual-processor Pentium II will pay off. In our tests, the second processor provided a nearly 50 percent performance boost for some functions—more than enough to justify the cost of the second processor for performance-hungry graphics users.

For most users, 1998 will be the time to

5/95 The Pentium and Win NT platform gives corporate power users a stable, secure environment.

11/95 Pentium Pro with Win NT gives developers and engineers affordable, near-RISC workstation-level performance.

October  
OS/2 Warp, Version 3

1995 February  
PowerPC 603e, 100 MHz  
98-mm<sup>2</sup> die, 2.6 million transistors

May  
Windows NT 3.51

July  
Cyrix 5x86, 100 MHz  
144-mm<sup>2</sup> die, 1.9 million transistors

August  
Windows 95

November  
Intel Pentium Pro; 150, 200 MHz  
196-mm<sup>2</sup> die, 5.5 million transistors  
First sixth generation x86, is mounted in a new dual-cavity package with L2 cache on-board running at full CPU speed; optimized to run 32-bit code

Cyrix 6x86, 100 MHz (PR120)  
173-mm<sup>2</sup> die, 3 million transistors

1996 February  
OS/2 Warp Server, Version 4

March  
AMD K5, 75 MHz (PR75)  
177-mm<sup>2</sup> die, 4.3 million transistors

July  
Windows NT 4.0

1997 January  
Intel Pentium MMX, 166 MHz  
128-mm<sup>2</sup> die, 4.5 million transistors

Adds 57 multimedia instructions to the x86 instruction set, unchanged since 1985.

February  
Cyrix MediaGX, 133 MHz  
134-mm<sup>2</sup> die, 2.4 million transistors  
Value-oriented chip with the graphics controller, DRAM controller, and PCI bus interface on-chip.

March  
DEC Alpha 21164PC, 400–533 MHz  
137-mm<sup>2</sup> die, 3.4 million transistors



## TEST SPOTLIGHT

### 2D 3D WinMark 97\*

As these results show, for top 3-D performance for games or image editing programs, choose Pentium II processors

\* Run under Windows 95 with 32MB RAM

|                           |      |
|---------------------------|------|
| AMD K5-PR166              | 3.0  |
| Cyrix 6x86-PR200          | 3.4  |
| Intel Pentium/200         | 3.9  |
| Intel Pentium MMX/200     | 22.3 |
| Intel Pentium MMX/233     | 25.7 |
| AMD K6/200                | 18.6 |
| AMD K6/233                | 21.2 |
| Cyrix 6x86MX-PR233        | 16.1 |
| Intel Pentium Pro/200     | 19.1 |
| Intel Pentium II/233      | 31.1 |
| Intel Pentium II/266      | 34.9 |
| Intel Pentium II/300      | 37.5 |
| Dual Intel Pentium II/266 | 34.1 |
| Dual Intel Pentium II/300 | 37.1 |

BETTER ▶

buy the Pentium II. That's when systems will have Intel's new LX chip set with Accelerated Graphics Port (AGP) support, the successor to Windows 95 (code-named Memphis and required to support AGP fully) will be out, Pentium II prices will be lower, and clock speeds will be higher.

Keep in mind that these conclusions represent a snapshot in time. As each vendor delivers new versions of its CPUs, the best choices will change. New system architectures like AGP, new graphics accelerators, and new applications will also change each processor's performance profile.

### UNDERSTANDING INTEL'S LINEUP

After a very slow year in 1996, Intel revamped its entire product portfolio in the first half of this year. Both the Pentium and the P6 lines got new versions with MMX, and Intel made a major change in the packaging of its P6 processors.

Intel created the MMX extensions to enable x86 processors to perform repetitive tasks on long streams of data more efficiently. The heart of MMX is its ability to operate on 64 bits of data at a time, treat-

ing those 64 bits as 8 items of 8 bits each, 4 items of 16 bits each, or 2 items of 32 bits each. This provides for parallel computations that make certain tasks go much more quickly. MMX is most beneficial for image processing and video functions. It also reduces the processor load for performing modem or audio functions.

The Pentium MMX processor, officially called the Pentium Processor with MMX Technology and code-named the P55C, not only adds the MMX instructions but also has twice as much on-chip Level 1 (L1) cache (16K each for instructions and data) as the original Pentium and uses a modified internal pipeline design. The larger cache size makes the chip about 10 to 20 percent faster than the earlier Pentium even for applications that do not benefit from MMX. (For detailed technical reviews of all the processors covered in this article, see MDR's *Microprocessor Report* at [www.mdronline.com/pc\\_processors](http://www.mdronline.com/pc_processors).)

The first P55C processor was manufactured using a pure CMOS version of the 0.35-micron BiCMOS process that Intel used for the earlier Pentiums. The new process eliminates bipolar transistors, which had helped to improve speed but are of diminishing value as process technology advances. The CMOS process technology enables the chip to operate at a lower voltage, slashing power consumption, reducing heat, and making it possible to achieve higher clock speeds in portable systems.

In September, Intel will begin shipping the second-generation version of the P55C, code-named Tillamook and manufactured with 0.25-micron CMOS technology. This more advanced technology enables Intel to reduce the supply voltage for the CPU core from 2.5V to 1.8V, further reducing power consumption. With Tillamook, even notebook PCs will be able to run at 233 MHz. (For more information, see the sidebar

## Microprocessor Pricing

OEM pricing in quantities of 1,000, as of 8/1/97

### AMD K6

|         |       |
|---------|-------|
| 166 MHz | \$109 |
| 200 MHz | \$189 |
| 233 MHz | \$289 |

### Cyrix 6x86MX

|                 |       |
|-----------------|-------|
| PR166 (150 MHz) | \$95  |
| PR200 (166 MHz) | \$180 |
| PR233 (188 MHz) | \$280 |

### Intel Pentium MMX

|         |       |
|---------|-------|
| 166 MHz | \$145 |
| 200 MHz | \$252 |
| 233 MHz | \$386 |

### Intel Pentium II

|         |        |
|---------|--------|
| 233 MHz | \$530* |
| 266 MHz | \$688* |
| 300 MHz | \$851* |

### Cyrix MediaGX

|         |       |
|---------|-------|
| 150 MHz | \$65  |
| 166 MHz | \$81  |
| 180 MHz | \$110 |

\* Includes 512K of Level 2 cache

"Mobile Processors Lag Desktops.")

Think carefully before spending too many extra dollars for a 233-MHz CPU instead of the 200-MHz model. Because the Pentium MMX has only 32K of L1 cache and is limited by its 66-MHz system bus and the speed of memory and I/O devices, Business Winstone scores increase only slightly with the 233-MHz chip. For CPU-intensive tasks

[www.pcmag.com](http://www.pcmag.com)

See the online version of this story, featuring the 12 tested processors and the 2 dual-processor configurations in an interactive price/performance chart, at [www.pcmag.com](http://www.pcmag.com).

Lower-cost chip intended to compete with mainstream x86 desktops.

**April**  
**AMD K6; 166, 233 MHz**

162-mm<sup>2</sup> die, 8.8 million transistors  
Originally a NexGen design, incorporates MMX and competes with Pentium II at the same MHz level.

**May**  
**Intel Pentium II; 233, 300 MHz**

203-mm<sup>2</sup> die, 7.5 million transistors  
Mainstream Pentium Pro with MMX

instructions; introduces new cartridge and connector design; comfortable running Windows 95.

**Cyrix 6x86MX; 133 MHz (PR166), 187.5 MHz (PR233)**

194-mm<sup>2</sup> die, 6 million transistors  
Has MMX and is meant to compete with Pentium MMX and Pentium IIs.

**June**  
**PowerPC 604e; 166, 200 MHz**

148-mm<sup>2</sup> die, 5.1 million transistors

**September**  
**Intel Pentium MMX mobile; 200, 233 MHz**

95-mm<sup>2</sup> die, 4.5 million transistors  
First Intel CPU using .25μ process; uses just 1.8V internally.

### FUTURE:

Late 1997 or early 1998  
**Windows 95 successor (Memphis)**

**1998**  
**Intel Deschutes, 300–400 MHz**  
Intel's first mobile Pentium II.

**Windows NT 5 (Cairo)**

**Intel Katmai**  
Pentium II design with rumored MMX2, a 100-MHz system bus, larger L1 cache.

**Intel Willamette**  
Enhanced Pentium Pro core; may outrun Pentium II and Deschutes by 50 percent.

**1999**  
**Intel/HP Merced**

May have a 300-mm<sup>2</sup> die and run at 600 MHz, 64-bit chip, the beginning of IA-64 architecture, (will still run x86 code).



# Testing Matrix

*We selected fifth- and sixth-generation processors and put them through a variety of tests to isolate their particular strengths and weaknesses in diverse application scenarios. We did not evaluate some processors in particular tests, because they are unlikely to be used under those conditions. Also, in some cases we looked for general trends where a sampling approach sufficed.*

## Windows 95

### Tested processors:

AMD K5-PR166 (116.7 MHz), K6/200, and K6/233; Cyrix 6x86-PR200 (166 MHz) and 6x86MX-PR233 (187.5 MHz); and Intel Pentium/200, Pentium MMX/200, Pentium MMX/233, Pentium Pro/200, Pentium II/233, Pentium II/266, Pentium II/300, dual Pentium II/266, and dual Pentium II/300.

### Tests run with 32MB and 64MB RAM:

ZD Business Winstone 97, CPUmark<sub>16s</sub>, and CPUmark<sub>32</sub>.

### 32MB RAM only:

ZD 3D WinMark 97 (hardware emulation), 3D WinMark 97 (with Diamond 3D card), and 3D WinMark 97 (with Leadtek 3D card).

We did not run the ZD 3D WinMark 97 tests with the Diamond and Leadtek cards on the AMD K5-PR166, the Cyrix 6x86-PR200, and the Intel dual Pentium II/266 and dual Pentium II/300.

## Windows NT

### Tested processors:

AMD K5-PR166 (116.7 MHz), K6/200, and K6/233; Cyrix 6x86-PR200 (166 MHz) and 6x86MX-PR233 (187.5 MHz); and Intel Pentium/200, Pentium MMX/200, Pentium MMX/233, Pentium Pro/200, Pentium II/233, Pentium II/266, Pentium II/300, dual Pentium II/266, and dual Pentium II/300.

### Tests run with 32MB and 64MB RAM:

ZD Business Winstone 97, High-End Winstone 97, CPUmark<sub>16s</sub>, and CPUmark<sub>32</sub>.

### Tests run with 128MB RAM:

AutoCAD, Photoshop Gaussian Blur (an MMX test), Photoshop Lighting Effects (a floating-point test), Photoshop Unsharp Mask (an MMX test), and Pro/Engineer.

### 32MB RAM only:

Synthetic floating-point (FP) test.

### 64MB RAM only:

ZD Business Winstone 97 with systems using a 10,000-rpm SCSI hard disk instead of the standard 5,400-rpm EIDE hard disk used for all other tests.

We ran the ZD Business Winstone 97 tests with the SCSI disk only on systems with the following: AMD K6/200 and K6/233; Cyrix 6x86MX-PR233 (187.5 MHz); and Intel Pentium/200, Pentium MMX/200, Pentium II/233, Pentium II/266, and Pentium II/300.

We did not run the Pro/Engineer and AutoCAD tests with the AMD K5-PR166 or the Cyrix 6x86-PR200.

## OUR CONTRIBUTORS

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## EQUIPMENT PROVIDERS

To set up our test bed, PC Magazine and PC Labs acquired products from the following vendors, whom we thank for their assistance: First International Computer of America (800-342-2638; [www.fica.com](http://www.fica.com)), Hewlett-Packard Co. (800-752-0800; [www.hewlett-packard.com](http://www.hewlett-packard.com)), and Tyan Computer Corp. (408-958-8000; [www.tyan.com](http://www.tyan.com)) for sending motherboards; IBM Corp. (800-426-3333; [www.ibm.com](http://www.ibm.com)) and Seagate Technology (408-438-8111; [www.seagate.com](http://www.seagate.com)) for hard disks; Kingston Technology Corp. (800-337-8410; [www.kingston.com](http://www.kingston.com)) for memory; Diamond Multimedia Systems (800-488-5848; [www.diamondmm.com](http://www.diamondmm.com)) and Leadtek Research (510-490-8078; [www.leadtek.com](http://www.leadtek.com)) for graphics adapters; and Adaptec (800-442-7274; [www.adaptec.com](http://www.adaptec.com)) for SCSI disk controllers. Several vendors supplied systems for our tests: Compaq Computer Corp. (800-345-1518; [www.compaq.com](http://www.compaq.com)), CyberMax Computer (800-345-8939; [www.cybermax.com](http://www.cybermax.com)), Digital Equipment Corp. (800-344-4825; [www.digital.com](http://www.digital.com)), GST/Micro City (800-567-2764; [www.aapogee.com](http://www.aapogee.com)), Polywell Computers (800-999-1278; [www.polywell.com](http://www.polywell.com)), Tagram System Corp. (800-824-7267; [www.tagram.com](http://www.tagram.com)), Tangent Computer (800-342-9388; [www.tangent.com](http://www.tangent.com)), and TigerDirect (800-830-0056; [www.tigerdirect.com](http://www.tigerdirect.com)).

such as Photoshop filters, however, the boost is over 10 percent.

## THE EVOLVING P6 FAMILY

In the Pentium line, the changes to the chip (except for the supply voltage) are entirely internal; the only change needed to motherboards is an adjustment to the power supply circuits. In the P6 line (which includes the Pentium II), on the other hand, the changes have been more radical.

The Pentium Pro, the first member of the P6 family, takes a novel packaging approach. The processor chip is mounted in a dual-cavity package, along with a custom Level 2 (L2) cache chip. The connections between the processor and the cache chip are within the package, making it easier to run the cache at high speeds. In fact, the L2 cache in the Pentium Pro runs at the same speed as the processor—in a 200-MHz Pentium Pro, transfers between the processor and the cache run at the full 200-MHz rate.

This design approach enabled Intel to extract the maximum performance from

its first P6 processor at the time of its introduction. In the long run, however, it doesn't make sense. First, the dual-cavity package is expensive. Second, the custom cache chip uses a considerable amount of Intel's precious fabrication capacity. Finally, the full-speed cache interface makes it difficult to increase the processor speed.

The Pentium II is the second-generation member of the P6 family. In addition to having the MMX instructions, this chip has twice as much L1 cache as the Pentium Pro—16K each for instructions and data, instead of 8K each—and it communicates with the L2 cache at one-half the processor's clock speed, instead of at the full rate.

Rather than being packaged with a custom L2 cache chip in a dual-cavity ceramic package, the Pentium II is mounted in a conventional, single-chip package that provides separate connections for the system bus and the L2 cache interface. Intel doesn't sell this chip by itself, however; the processor is mounted on a small circuit board along with SRAM chips for the L2

cache. This circuit board assembly, which Intel calls the SEC (Single Edge Contact) cartridge, is then wrapped in a plastic-and-metal enclosure. This entire assembly is what Intel calls the Pentium II.

The Pentium II's L2 cache interface is half as fast as that of the Pentium Pro's, but the larger L1 cache on the CPU mitigates this somewhat. More important, the half-speed cache interface makes it much easier to increase the CPU clock speed; the Pentium II is now available at 233-, 266-, and 300-MHz speeds, and new versions are slated to reach 400 MHz next year.

Using other manufacturers' cache RAM for Pentium II frees Intel's manufacturing capacity and the SRAM market's high competitiveness keeps Intel's costs low. This has enabled Intel to make 512K of L2 cache standard on the Pentium II; the 512K cache version of the Pentium Pro is expensive and rarely used. The net effect is that while the Pentium II has a slower L2 cache interface, it has twice as much L1 and L2 cache.



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August 1997

\* Estimated street prices. All performance tests conducted by Matrox Graphics Inc. Windows NT 4.0 tests conducted on a Dell Pentium® Pro 200 MHz with 32 MB of EDO DRAM and 256K cache. Matrox Millennium II, Diamond Stealth 3D 3000, and Number Nine Imagine 128 Series 2 were tested using driver releases 3.12, 3.12, 3.12, 2.03, and 4.102.30 respectively. WinBench 97 business tests conducted at 1024x768 @ 24-bit at 75 Hz using small fonts under Windows NT. Pentium is a registered trademark of Intel Corporation.

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# Microprocessor Features *See how today's processors compare on key features*

| ■ YES ■ NO                          | AMD K5                     | AMD K6                    | Cyrix MediaGX           | Cyrix 6x86                            | Cyrix 6x86MX                          | Intel Pentium           | Intel Pentium MMX                    | Intel Pentium Pro           | Intel Pentium II          |
|-------------------------------------|----------------------------|---------------------------|-------------------------|---------------------------------------|---------------------------------------|-------------------------|--------------------------------------|-----------------------------|---------------------------|
| <b>Clock speeds (MHz)</b>           | 100 (PR133), 116.7 (PR166) | 166, 200, 233             | 120, 133, 150, 166, 180 | 110 (PR133), 133 (PR166), 150 (PR200) | 150 (PR166), 166 (PR200), 188 (PR233) | 133, 150, 166, 200      | 166, 200, 233; mobile: 133, 150, 166 | 166, 180, 200               | 233, 266, 300             |
| <b>Level one (L1) cache</b>         | 16K instruction, 8K data   | 32K instruction, 32K data | 16K unified             | 16K unified                           | 64K unified                           | 8K instruction, 8K data | 16K instruction, 16K data            | 8K instruction, 8K data     | 16K instruction, 16K data |
| <b>Level two (L2) cache</b>         | Controlled by chip set     | Controlled by chip set    | None                    | Controlled by chip set                | Controlled by chip set                | Controlled by chip set  | Controlled by chip set               | 256K or 512K in CPU package | 512K on CPU module        |
| <b>L2 cache speed</b>               | Same as bus                | Same as bus               | N/A†                    | Same as bus                           | Same as bus                           | Same as bus             | Same as bus                          | Full CPU speed              | Half CPU speed            |
| <b>Type of bus</b>                  | Socket 7                   | Socket 7                  | None (PCI)              | Socket 7                              | Socket 7                              | Socket 7                | Socket 7                             | Equivalent to Slot 1        | Slot 1                    |
| <b>Bus speed (MHz)</b>              | 60–66                      | 66                        | N/A†                    | 55–75                                 | 60–75                                 | 60–66                   | 60–66                                | 60–66                       | 66                        |
| <b>Instructions per clock cycle</b> | 2                          | 2                         | 1                       | 2                                     | 2                                     | 2                       | 2                                    | 3                           | 3                         |
| <b>MMX units</b>                    | None                       | 1                         | None                    | None                                  | 1                                     | None                    | 2                                    | None                        | 2                         |
| <b>Pipelined FPU</b>                | ■                          | ■                         | ■                       | ■                                     | ■                                     | ■                       | ■                                    | ■                           | ■                         |
| <b>Out-of-order execution</b>       | ■                          | ■                         | ■                       | ■ (limited)                           | ■ (limited)                           | ■                       | ■                                    | ■                           | ■                         |
| <b>Process technology</b>           | 0.35µ CMOS                 | 0.35µ CMOS                | 0.35µ CMOS              | 0.35µ CMOS                            | 0.35µ CMOS                            | 0.35µ BiCMOS            | 0.35µ CMOS                           | 0.35µ BiCMOS                | 0.35µ CMOS                |
| <b>Die size</b>                     | 177 mm²                    | 162 mm²                   | 131 mm²                 | 169 mm²                               | 197 mm²                               | 90 mm²                  | 128 mm²                              | 196 mm²*                    | 203 mm²                   |
| <b>Transistors</b>                  | 4.3 million                | 8.8 million               | 2.4 million             | 3 million                             | 6.5 million                           | 3.3 million             | 4.5 million                          | 5.5 million*                | 7.5 million               |

N/A†—Not applicable: The processor and its chip set do not support this feature. N/A‡—Not applicable: The processor does not have a separate bus; it uses the PCI bus. \* CPU chip only

Today, the Pentium II is more expensive than the Pentium Pro (with 256K of L2 cache). This is a reflection not of cost, but of value: The Pentium II runs at a higher clock speed and has MMX. Pentium Pro prices are likely to decline very little, however, while Pentium II prices will decline steadily. By next spring, the Pentium II is likely to cost less than the Pentium Pro.

The 266-MHz Pentium II is likely to be the most popular version; for a high-end PC, another couple of hundred dollars for the faster chip is not unreasonable. You'll get a 5 to 6 percent boost on Winstone over the 233-MHz model, and about a 10 percent boost on CPU-intensive tasks such as Photoshop filters. The 300-MHz chip, originally priced for the workstation market, has dropped significantly, bringing it to the realm of desktop CPUs. But the performance benefit of the 300-MHz chip over the 266-MHz chip is smaller than that of 266 MHz over 233 MHz, which makes even the diminished price differential less appealing for most.

One limitation of the current Pentium II is that it supports only two CPUs per system, not four as with the Pentium Pro. Because of this, many server designs will stay with the Pentium Pro for the rest of this year. Even some single- and dual-

processor servers will stick with the Pentium Pro, because its faster L2 cache interface may outweigh the benefit of larger caches and higher clock speeds when running data-intensive server applications. Servers also typically don't benefit from MMX. In 1998, however, new versions of the Pentium II (described later in this article) will take over the server market as well, making the Pentium Pro obsolete.

## AMD'S K SERIES

AMD's K5 was the company's first independently created x86 processor; previously, AMD made 286, 386, and 486 CPUs that were directly derived from Intel's designs. Because AMD underestimated the difficulty of creating an independent design and made some bad design choices, the K5 was late to market and has been limited to entry-level systems. By the end of this year, the K5 is likely to disappear.

AMD's future lies with the K6, which began shipping this spring. The K6 started life as NexGen's 686; when AMD ran into trouble with the K5, it bought NexGen to get its 686 design and the team that created it. The K6 has MMX, more on-chip cache (32K each for instructions and data), is able to process more instructions in paral-

lel, and runs at higher clock speeds than the K5 processor.

For the K5, which delivers better-than-Pentium performance at the same clock speed, AMD used the PR rating system. A 100-MHz K5, for example, delivers Winstone performance comparable to that of a 133-MHz Pentium, so AMD calls it the K5-PR133. With the K6, however, AMD has gone back to a MHz rating. This change was driven by the shift in the reference from Pentium to Pentium MMX and Pentium II. No longer is there a single clear scale for comparison—and the raw MHz numbers turn out to describe AMD's positioning adequately.

Based on Business Winstone running under Windows 95, AMD positions the 166- and 200-MHz K6 chips as being more powerful than the Pentium MMX at those speeds—a position supported by our tests. Using the same criteria, AMD positions the K6/233 as comparable to the Pentium II/233; according our tests, it comes close, but falls a few percentage points short. It is easily faster than a Pentium MMX/233, however, delivering a Business Winstone 97 score 7 to 9 percent higher than that of the Intel chip. The K6's larger L1 cache enables it to deliver more of a performance boost than the



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# Mobile Processors Lag Desktops

By Michael Slater

**I**n the mobile environment, the microprocessor's power dissipation is a big issue for two reasons. First, the higher the power dissipation, the lower the battery life. Second, power is dissipated as heat, so high power dissipation makes for a hot system that requires considerable airflow for cooling.

Unfortunately, leading-edge processors consume too much power for portable PCs. Power dissipation is proportional to the number of transistors and the clock speed, so rising processor complexity and clock rates have pushed power consumption from a few watts in the 486 era to more than 25 watts for the Pentium II. In a notebook system, 10 watts is about the most that can be tolerated. There is one saving grace: As semiconductor technology advances, the power supply voltage can be reduced. Because power consumption is proportional to the square of the supply voltage, modest reductions in voltage

create big reductions in power.

The latest CPUs will continue to be unsuited for portable applications until they have matured for two or three years. Today's Pentium Pro and Pentium II, for example, are too power-hungry for notebooks. The latest Pentium MMX version, code-named Tillamook, is fabricated in 0.25-micron technology and operates from a 1.8V power supply. This chip will bring high-end Pentium performance—up to 233 MHz—to notebooks, and this will have to suffice for the rest of this year. Early in 1998, the 0.25-micron version of the Pentium II (code-named Deschutes) will debut, and this chip will cut power consumption to below 10 watts and make portable P6-family systems practical.

To ease the transition to Deschutes, Intel has begun making Mobile Modules, which combine a Pentium MMX CPU with L2 cache and part of the system-logic chip set. Intel will make a

module with near-identical physical, electrical, and thermal specifications using Deschutes, enabling notebook makers using Pentium Mobile Modules to quickly revise their systems for Deschutes.

AMD and Cyrix have not pursued the mobile market because their CPUs have been more power-hungry than Intel's. As they move to more advanced manufacturing processes, however, the power consumption of the K6 and 6x86MX will fall into the mobile range, so you may see notebooks using AMD and Cyrix CPUs in 1998. AMD and Cyrix could also put their future CPUs on Intel-compatible Mobile Modules.

IDT's IDT-C6 CPU, developed by its Centaur Technology subsidiary, was designed from the start with low power consumption as a primary target. IDT will seek mobile as well as desktop design wins. (For more information, see the sidebar "New Low-Cost MMX Alternative from IDT.")

Intel chip as frequency increases.

Where the K6 falls short is on applications that use MMX or floating-point (FP) instructions. AMD did not devote as much silicon to these functions as Intel did. AMD's MMX unit can process only one instruction at a time, for example, while Intel's can handle two.

FP and MMX performance depends on two measures: latency and throughput. Latency is the time from the start of an operation to its completion. It is the defining factor for a single, isolated computation whose results are needed before processing can continue. Throughput is the rate at which new operations can be started; in a pipelined multiplier or FP unit, two or more operations can be overlapped, allowing a faster throughput rate but increasing the latency. All of Intel's CPUs have fully pipelined MMX and FP units, so a new operation can be started with each clock cycle—even though the results may not be available until several cycles later. When performing a long series of computations, as is typical in multimedia applications, throughput is more important than latency.

AMD's K6 has better latency than Intel's processors on some MMX operations, but the throughput for individual operations is the same, and the shorter latency doesn't compensate for the inability to handle two MMX instructions at once. (Intel's MMX unit has only one multiplier and one shifter, though, so it cannot perform both of these critical operations at one time. Also, only one MMX instruction can access memory or the integer registers at a time.) On the FP side, the K6 again has shorter latencies than Intel's processors for some instructions, but it can only start one operation every two cycles, while Intel's chips can start one operation every cycle. As a result, its throughput on many FP operations is half that of the Intel units.

These weaknesses show up as poorer performance on our ZD 3D WinMark 97, synthetic floating point, Pro/Engineer, AutoCAD, and some Photoshop tests. On most of these tests, the K6/233 is much slower than a Pentium II/233 and sometimes even slower than a Pentium MMX/233. On 3D WinMark, for example, the K6/233 delivers only about two-thirds

the performance of a Pentium II/233 when using software emulation for all 3-D tasks. With a good 3-D graphics card, this gap shrinks to 18 percent, which is still considerable. Compared with a Pentium MMX/233, the K6/233 is 18 percent short on emulated 3-D, and is still 7 percent short even with a good graphics card.

## CYRIX'S 6X86 FAMILY

The recent acquisition of Cyrix by National Semiconductor has the potential to strengthen the company's position by eliminating its dependence on outside chip foundries. (All of Cyrix's chips are currently made by IBM Microelectronics.) National's manufacturing facilities have been lagging in technology, but the company is moving quickly to increase its capability. National plans to focus particularly on creating highly integrated "PC-on-a-chip" devices, taking the concept of Cyrix's MediaGX one step further. (For more information, see the sidebar "Cyrix MediaGX Offers Entry-Level Option.")

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| Standard Cache/Max.        | 256KB / 512KB           | 512KB / 512KB           | 512KB / 512KB              |
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After the usual delays from technical and manufacturing challenges, acceptance of the 6x86 was initially slow because Cyrix priced it too high—mistakenly thinking that since the chip's performance was comparable to Intel's, its price could be too. Once Cyrix readjusted its sights and accepted its position as a lower-cost Intel alternative, sales picked up considerably.

With much of the market moving to processors with MMX, Cyrix has shifted its production entirely to the new 6x86MX. The 6x86MX is derived from the 6x86, with the addition of MMX instructions, a few enhancements to the FP unit, four times as much L1 cache (64K total), and an enhanced memory-management unit.

The 6x86 architecture remains essentially the same, with a dual-pipeline design similar to the Pentium's but more flexible. Intel's Pentium II and AMD's K6 use a more complicated approach that translates x86 instructions into simple internal instructions, which are then acted on by a sophisticated processing core that can handle four or more of the internal instructions in parallel. Cyrix's approach delivers better Winstone performance at a given clock speed, but the Intel and AMD approach can achieve higher clock speeds.

Unlike AMD, Cyrix is continuing with the PR rating scheme for the 6x86MX. The 6x86MX-PR233 runs at a clock speed of only 187.5 MHz, yet it delivers better Business Winstone performance than the Pentium MMX/233 or the Pentium Pro at 200 MHz, under both Windows 95 and Windows NT. Thus, it earns its PR233 rating. In fact, in our tests the 6x86MX-PR233 was an impressive 10 to 11 percent faster than the Pentium MMX/233 on Business Winstone, although on High-End Winstone, it was only 3 percent faster at 32MB and essentially tied at 64MB. It even matched the performance of the Pentium II/233 on Business Winstone.

Like AMD's K6, however, the 6x86 falls short on MMX and FP performance—it is even slower than the K6 on these functions. As a result, its 3-D performance is quite poor: With emulated 3-D, the 6x86MX-PR233 had only 63 percent of the performance of the Pentium MMX/233. Even with a good graphics card, the gap remained a substantial 27 percent, making the 6x86MX the worst of the crop for 3-D.

The 6x86MX delivered surprisingly

## The Alpha Alternative

By Michael Slater

**F**or the performance-driven user, Digital Equipment Corp.'s Alpha architecture offers an interesting alternative. The Alphas are the fastest of all the RISC processors and the only ones for which Microsoft Windows NT support has been maintained (NT support for MIPS and PowerPC was dropped last year). If your productivity is limited by the performance of one or two high-end applications, and those applications are available for Alpha, then an Alpha system may be a good choice.

Today's Alpha processor is the 21164, which Digital offers at clock speeds from 300 to 600 MHz. On integer applications, the performance increase over Intel's Pen-

tium II is not as great as the clock rate advantage suggests; while the clock speed is high, the amount of work done in each clock cycle is lower. The actual performance advantage varies greatly depending on the application. For floating-point applications such as 3-D graphics and computer-aided design, the 21164 is a stellar performer.

Technically, the 9.6-million-transistor 21164 is an impressive design. It has 16K of on-chip Level 1 cache plus 96K of on-chip Level 2 cache. The system bus is 128 bits wide, enabling it to deliver much higher bandwidth than the 64-bit bus in x86-based systems.

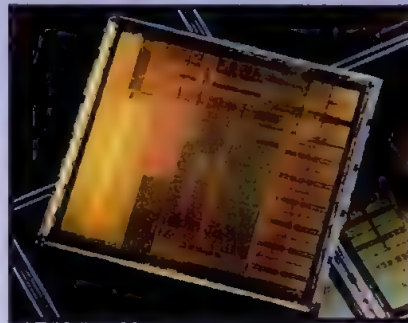
The challenge all RISC processors have faced in attacking the PC market is a lack of application software. Digital has aggressively pursued software developers and has assembled an impressive catalog of applications, but they tend to be in the engineering and authoring areas—not mainstream PC applications.

To address this problem, Digital

has developed an interesting software product, called FX!32, that enables the Alpha to run nearly all 32-bit x86 Windows applications. Performance is much better than with other software emulators, such as SoftPC, but is only about 50 to 70 percent of that of native Alpha code (according to Digital). FX!32 is a good way to get access to a more complete suite of applications—it may save you from needing an x86 PC in addition to an Alpha system—but it is unlikely to deliver leadership

performance or value.

Most Alpha systems are far more expensive than typical PCs. Digital is sampling a new processor, called the 21164PC, that is less expensive than the original 21164 yet deliv-



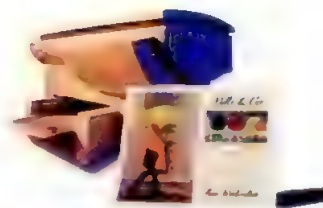
The Alpha packs 96K of L2 cache on-chip.

ers nearly as much performance. It will be offered at clock speeds of 400, 466, and 533 MHz. Prices for the new processor are expected to be about \$495 (533 MHz) in quantities of a thousand, compared with \$1,450 for the 500-MHz 21164 or with Intel's Pentium MMX, for example, priced at \$386 for the 233-MHz part.

Digital expects systems using this chip to appear by the end of this year, at prices as low as \$2,500. With these lower-cost systems, Alpha will be able to address more of the PC market—if there are enough native applications to lure users.

Next year, Digital plans to begin shipping the 21264, which should leave even Intel's best x86 processor in the dust, especially in FP performance. Until 1999 or later, however, systems using this chip are likely to be priced above \$10,000—often way above. If price is no object and you want the world's fastest Windows NT system, this is the processor to watch for.

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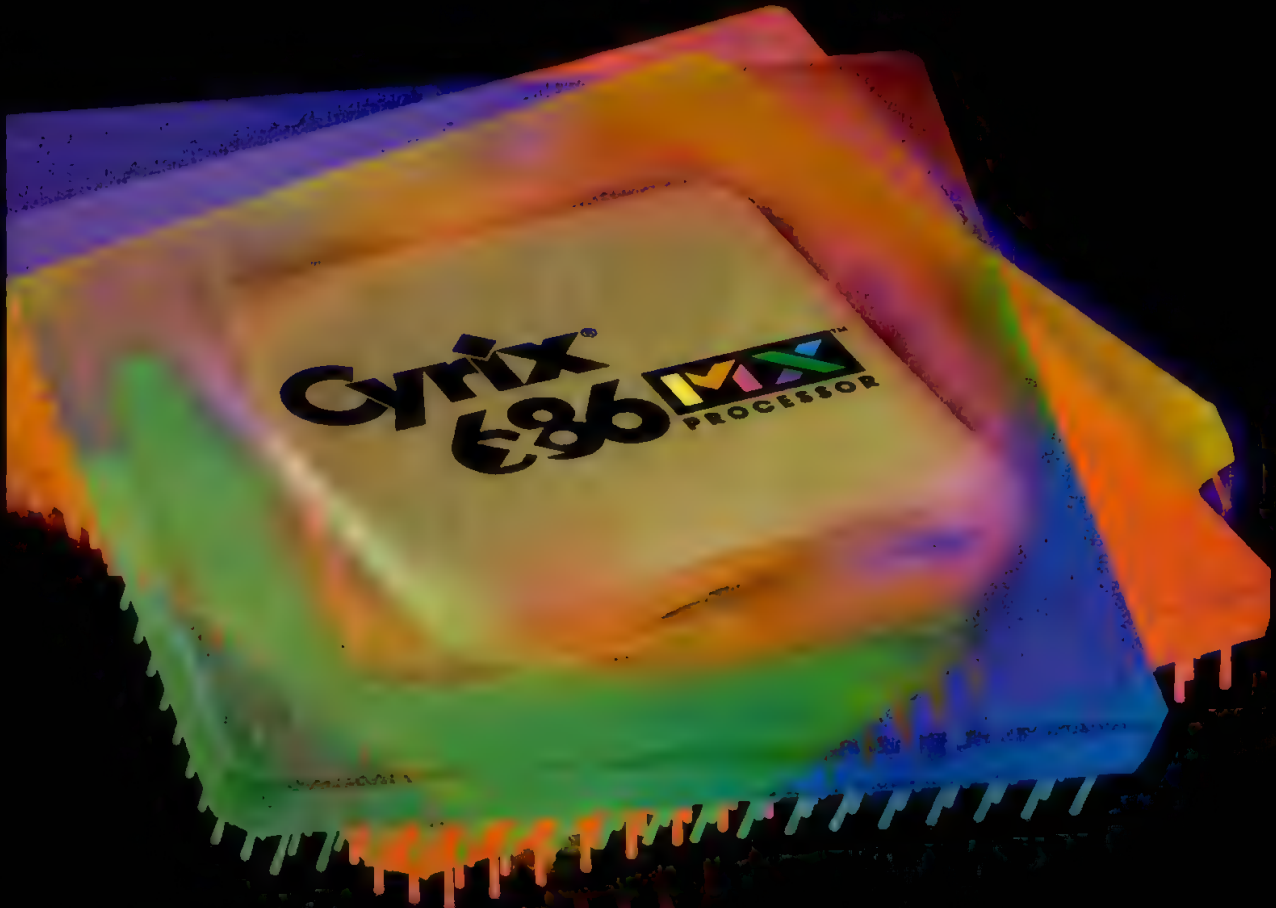


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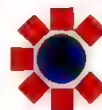
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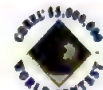
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## Cyrix MediaGX Offers Entry-Level Option

By Michael Slater

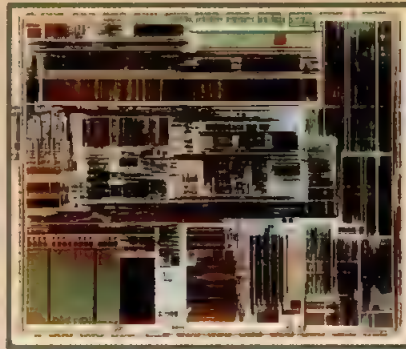
**W**hile Cyrix targets midrange PCs with the 6x86MX, it has an entirely different solution for entry-level systems: the MediaGX. Unlike all the other Intel alternatives, this chip provides a higher level of integration than anything Intel offers. As a result, the chip requires a custom motherboard design and is not Pentium pin-compatible. The benefit is that the MediaGX delivers the lowest system cost available today for a Pentium-class system. However, the MediaGX is not a stellar performer.

Cyrix scored a design win with this chip with Compaq Computer Corp. Used in the Presario 2100 and 2200, this chip was compelling for Compaq because it addresses a price point for which Intel simply has no product.

The MediaGX combines, on a single chip, the processor (based on Cyrix's older 5x86 processor), graphics controller, DRAM controller, and PCI bus interface. The graphics controller uses the "unified memory architecture" approach, in which part of the

main DRAM memory is used for display memory, instead of the usual separate set of memory chips.

A MediaGX-based unit is less



**The MediaGX's tight integration lowers costs.**

expensive to make because the MediaGX is less expensive than the least costly Pentium-compatible processor and because the need for the graphics chip, one of the system logic chips, and the graphics memory chips has been eliminated. It also requires no Level 2 cache.

Originally intended to reach the market in 1996, the MediaGX took

longer than expected, not because of delays with the chip but because of the software and motherboard support it requires. Today, the MediaGX represents the low end of the market in terms of performance. Not only are the clock speeds modest, but the chip lacks features common in many systems today, such as support for USB ports, MMX instructions in the processor, and 3-D and video acceleration in the display controller. As a result, its 3-D performance is poor, which means a MediaGX-based system is not a good alternative for game-focused PC buyers.

Cyrix plans to upgrade the MediaGX steadily—not to move into higher-end systems but just to keep pace. As Intel makes slower Pentium processors obsolete and moves MMX down to the entry level, Cyrix must do the same. Cyrix originally offered the chip at 120 and 133 MHz; it recently introduced MediaGX processors at 150, 166, and 180 MHz. A 200-MHz version with MMX is due to ship by the end of the year.

good performance on AutoCAD, though it still fell far short of the Pentium II. On Photoshop, it was slower than the 233-MHz models of both the K6 and Pentium MMX.

### **SOCKET 7 VS. SLOT 1**

From a system hardware perspective, Cyrix and AMD are pursuing a strategy fundamentally different from Intel's. The Pentium MMX/233 is probably the end of the Pentium interface, called Socket 7, for Intel. For continued performance and technology increases, Intel is shifting to the Pentium II interface, called Slot 1.

AMD and Cyrix have stuck with Socket 7 for several reasons. First, the Slot 1 bus is complex, and details of its operation weren't publicly available when the design of the competing processors began. Second, Intel is believed to have system-level patents that could be asserted against system makers that used non-Intel Slot 1 processors. In AMD's case, there are rumored to be specific exclusions in the com-

pany's patent cross-license with Intel that limit what AMD can do with Slot 1. And fundamentally, Slot 1 simply isn't needed today for mainstream desktop systems.

Slot 1 uses an entirely different system bus from that of Socket 7. The Slot 1 bus, functionally identical to the Pentium Pro bus, is a highly pipelined design that allows many transactions to proceed in parallel. It also allows bus operations to finish in an order different from that in which they began. This design makes it much more effective for multiple-processor systems than the Socket 7 bus.

In a single-processor system—in other words, the vast majority of desktop systems—the Slot 1 bus advantages are minor. The Slot 1 design's big advantage in such systems is that there is a second bus, hidden inside the cartridge, that connects the processor to the cache SRAM. This approach, which Intel calls the Dual Independent Bus (DIB) architecture, enables the cache interface to run faster than the

system bus. It also makes it possible for Intel to use different cache interface speeds while keeping the system interface constant. At 266 MHz, the Pentium II L2 cache bus runs at 133 MHz—twice the speed of the 66-MHz system bus in a Pentium system. In addition, all of the system bus bandwidth is available for main memory and input/output traffic, whereas a Socket 7 system must handle L2 cache transactions on the system bus as well.

To mitigate the limitations of the Socket 7 bus bandwidth, AMD and Cyrix each gave their latest processors twice the L1 cache of Intel's Pentium MMX or Pentium II. This means that more memory accesses are satisfied by the on-chip cache, so there is less traffic on the system bus and its speed limits are less constraining. The fact that the L2 cache must run at the system bus speed, however, even as CPU speeds approach 300 MHz, is a serious limitation.

One way to get around this limit is to increase the system bus speed. Cyrix already



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**PC MAGAZINE  
JULY 1997**

SERVICE AND RELIABILITY SURVEY

When it comes to service and reliability, who's the one notebook maker you can truly count on? According to the nearly 8,500 people who responded to *PC Magazine's* 10th Annual Service and Reliability Survey, there is only one. (Impressive considering they rated some 3,800 notebooks from 15 vendors, isn't it?) How did we earn the only "A"? Over the last year, our users reported better than average scores on four key measures: satisfaction with reliability, repair experience, and technical support; and the need for recent repairs. They also said they'd buy one again. To say the same for your notebook, visit us on the Web or give us a call.



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## BENCHMARK TESTS

# Intel, AMD, and Cyrix x86 CPUs



AMD and Cyrix offer compelling, compatible, and cost-effective competition to Intel's x86 CPUs, especially for mainstream users. Still, 361 benchmark tests by PC Labs show an undisputed performance champion: the Pentium II processor.

## What the Numbers Mean

To understand how the fastest fifth- and sixth-generation x86-compatible microprocessors stack up, PC Labs tested 12 CPUs under two operating systems and three memory configurations—361 benchmark test runs in all. Intel's Pentium II prevailed in every category of testing. But it was clearly not the price/performance leader for mainstream business settings. In fact, there was relatively small variance in Business Winstone scores. (As its name implies, Business Winstone is a test of the most popular applications used in business.) AMD's K6 and Cyrix's 6x86MX did almost as well as the Pentium II and outperformed the Pentium MMX and classic Pentium by small margins.

The MMX and floating-point performances showed more divergence and better differentiated the CPUs in this story. In engineering applications that involve intensive floating-point calculation, or high-end image-editing applications that use MMX,

the Pentium II proved to be unequalled.

We minimized the effects of external factors on our CPU performance results by standardizing supporting hardware and operating systems, selecting components that represent typical desktop PCs. Because we used a uniform set of subsystem hardware in testing, the results here can be attributed mostly to the CPU, and, to some degree, to the motherboard. We chose to accept different motherboards that were certified and tuned for the specific CPUs in order to reflect real-world conditions.

### ZD Business Winstone 97

The Business Winstone 97 test produces a number that reflects a tested system's overall performance in a real business setting. In that sense, Winstone 97 is a better measure of a CPU's true effectiveness than even CPUmark.

The Pentium II processors scored best under all memory/OS configurations, but because of heavy use of I/O in running the applications that make up the Business Winstone test suite, sheer processor muscle does not shine through. As a result, there isn't much performance variation among the processors. Under the Windows NT/64MB configuration, the difference between the best CPU, the Pentium II/300, and the worst, the Pentium/200, is only 48 percent—a meager improvement considering the \$726 CPU price difference. The Cyrix 6x86MX-PR233 edged AMD's K6/233 and almost matched the Pentium II/233 on all Business Winstone runs. The Cyrix 6x86-PR200 outperformed (slightly) its Intel counterpart, the 200-MHz classic Pentium, and surprisingly, so did the AMD K5-PR166. All CPUs showed about the same relative performance under both operating

|                                             | WINDOWS 95              |      |                          |      | WINDOWS NT               |      |                         |      |
|---------------------------------------------|-------------------------|------|--------------------------|------|--------------------------|------|-------------------------|------|
|                                             | ZD Business Winstone 97 |      | ZD CPUmark <sub>16</sub> |      | ZD CPUmark <sub>32</sub> |      | ZD Business Winstone 97 |      |
|                                             | 32MB                    | 64MB | 32MB                     | 64MB | 32MB                     | 64MB | 32MB                    | 64MB |
| Higher scores represent better performance. |                         |      |                          |      |                          |      |                         |      |
| <b>FIFTH-GENERATION CPUs</b>                |                         |      |                          |      |                          |      |                         |      |
| AMD K5-PR166                                | 40                      | 41   | 277                      | 288  | 304                      | 318  | 44                      | 48   |
| Cyrix 6x86-PR200 ‡                          | 42                      | 43   | 370                      | 382  | 390                      | 390  | 46                      | 51   |
| Intel Pentium/200                           | 39                      | 40   | 375                      | 380  | 376                      | 374  | 44                      | 48   |
| Intel Pentium MMX/200                       | 44                      | 44   | 424                      | 428  | 405                      | 414  | 49                      | 54   |
| Intel Pentium MMX/233                       | 45                      | 46   | 479                      | 473  | 447                      | 450  | 51                      | 56   |
| <b>SIXTH-GENERATION CPUs</b>                |                         |      |                          |      |                          |      |                         |      |
| AMD K6/200                                  | 47                      | 48   | 420                      | 418  | 507                      | 506  | 52                      | 59   |
| AMD K6/233                                  | 49                      | 50   | 463                      | 461  | 552                      | 544  | 54                      | 62   |
| Cyrix 6x86MX-PR233                          | 50                      | 52   | 451                      | 482  | 500                      | 504  | 56                      | 63   |
| Intel Pentium Pro/200                       | 42                      | 43   | 358                      | 359  | 550                      | 554  | 54                      | 63   |
| Intel Pentium II/233                        | 51                      | 52   | 457                      | 458  | 607                      | 604  | 57                      | 67   |
| Intel Pentium II/266                        | 53                      | 54   | 522                      | 523  | 686                      | 689  | 60                      | 70   |
| Intel Pentium II/300                        | 54                      | 56   | 572                      | 572  | 745                      | 745  | 61                      | 71   |
| <b>DUAL-PROCESSOR PENTIUM II</b>            |                         |      |                          |      |                          |      |                         |      |
| Dual Intel Pentium II/266                   | 53                      | 54   | 522                      | 523  | 688                      | 685  | 57                      | 67   |
| Dual Intel Pentium II/300                   | 55                      | 56   | 588                      | 587  | 769                      | 765  | 59                      | 69   |

‡ Cyrix considers this a sixth-generation CPU, but the chip is positioned against Pentium-class processors



systems, except the Pentium Pro/200. Intel optimized this sixth-generation CPU to run true 32-bit operating systems like Windows NT. True to its calling, the Pentium Pro was in the 233-MHz K6 and 6x86MX class under Windows NT, but was barely faster than a classic Pentium/200 under Windows 95.

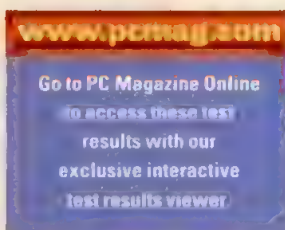
There's minimal gain in upgrading to 64MB from 32MB under Windows 95. But under Windows NT, where the OS occupies a larger memory footprint, the investment in extra memory brings a significant return of up to 18 percent in improved performance. We also found that the faster processors take better advantage of extra memory; as the hard disk's involvement is reduced, the CPU's power becomes more evident.

To empirically demonstrate the effect of a faster hard disk on the reduced I/O bottleneck, we also ran Business Winstone 97 at 64MB under Windows NT with a 10,000-rpm Ultra SCSI disk instead of our standard 5,400-rpm EIDE disk. This provided a minimal 1 to 2 percent benefit with most CPUs, while the fastest CPUs had improvements of 4 to 5 percent—better, but not significantly so. In scaling up Pentium II speeds, we saw minimal gain in going from 266 to 300 MHz, mainly due to the inadequacy of current system bus and I/O technologies. For more detailed discussion, turn to Inside PC Labs.

## ZD High-End Winstone 97

The computation-intensive applications in High-End Winstone 97 emphasize a CPU's abilities and include more floating-point calculations than Business Winstone. Because this test also involves applications with bigger memory footprints, it not only isolates the CPU's performance better than does Business Winstone, it also shows more drastic memory-scaling effects.

Pentium II distanced itself from the field in this test. For example, under Windows NT with 64MB, the Pentium II/233 outper-



formed the AMD K6/233 and the Cyrix 6x86MX-PR233 by a modest 8 and 6 percent, respectively, on Business Winstone, but the gap widened to 26 and 29 percent, respectively, on High-End Winstone. This change is also partially attributable to the Pentium II's superior floating-point ability. Whereas the Pentium II gained ground, AMD and Cyrix lost it: The small performance edge that the AMD K6 and the Cyrix 6x86MX held over the Pentium MMX/233

on Business Winstone shrank on High-End Winstone.

The Pentium Pro/200, on the other hand, excelled on High-End Winstone, proving itself a superior workstation processor to the K6 and the 6x86MX. From these findings we deduce that Intel's architecture is more proficient in processing high-end applications than AMD's and Cyrix's, which are optimized for business software. It is also quite possible that the programmers of processor-intensive applications tune their codes for Intel CPUs.

More memory has a bigger impact on High-End Winstone results than on Business Winstone results. In upgrading from 32MB to 64MB, we saw improvements ranging between 10 and 18 percent on Business Winstone under Windows NT. On High-End Winstone, the performance boost ranged from 24 to 54 percent. Again, faster CPUs take better advantage of additional memory.

## ZD CPUmark<sub>16</sub> and CPUmark<sub>32</sub>

In this story, Winstone measures a CPU's effectiveness; CPUmark shows its potential. CPUmark<sub>32</sub> and CPUmark<sub>16</sub> test the processor and its supporting silicon exclusively, eliminating disk and graphics subsystem effects as well as I/O delays, and can effectively ascertain the upper limit of the CPU's performance. The 32-bit results are more relevant for today's software environment, but the 16-bit test is valuable if you run legacy software under Windows 95 or Windows 3.1.

Comparisons between CPUmark<sub>16</sub> and CPUmark<sub>32</sub> results were most notable. All of the sixth-generation processors (the Pentium II, Pentium Pro, 6x86MX, and K6) jumped in relative performance going from 16-bit to 32-bit tests, proving that they are optimized for processing 32-bit codes. While the Pentium II, 6x86MX, and K6 still maintained superior 16-bit performance relative to the Pentium, the Pentium Pro clearly demonstrated why it's not a good CPU for mainstream Windows 95 PCs. Under Windows 95, its CPUmark<sub>16</sub> score was slightly lower than even the classic Pentium/200's result. But on CPUmark<sub>32</sub>, the 200-MHz Pentium Pro rivaled the K6/233 and surpassed the 6x86MX-PR233. Among Pentium-class CPUs, the Pentium MMX/233 was best, followed by the Pentium MMX/200. The Cyrix 6x86-PR200 did about as well as the classic Pentium; the AMD K5-PR166 trailed the other two by up to 28 percent.

## MMX Tests

To gauge MMX performance, we employed two different benchmark tests, Photoshop 4.01 (timing two MMX-enhanced filters, Gaussian Blur and Unsharpen Mask), and ZD 3D WinMark 97 (forcing a hardware emulation mode), which were inspired by two of the most common implementations of the MMX technology: workstation-class image rendering and 3-D games. We also tested the CPUs' 3-D performance in conjunction with 3-D accelerator cards (a more typical scenario); see the discussion below.

No test we ran differentiated the CPUs more than the two MMX tests. On Unsharpen Mask, the best CPU, the Pentium II/300, performed more than 5 times better than the worst, the AMD K5-PR166. On 3D WinMark, the Pentium II/300 scored 11 times higher than the Cyrix 6x86-PR200. At the same clock speed (or PR equivalent), the Pentium II/233 outperformed the K6/233 by 49

| ZD High-End Winstone 97 |      | ZD CPUmark <sub>16</sub> |      | ZD CPUmark <sub>32</sub> |      |
|-------------------------|------|--------------------------|------|--------------------------|------|
| 32MB                    | 64MB | 32MB                     | 64MB | 32MB                     | 64MB |
| 15                      | 18   | 262                      | 272  | 314                      | 316  |
| 15                      | 18   | 338                      | 357  | 378                      | 381  |
| 16                      | 19   | 314                      | 353  | 363                      | 365  |
| 17                      | 22   | 366                      | 401  | 402                      | 402  |
| 18                      | 23   | 395                      | 439  | 440                      | 440  |
| 17                      | 23   | 387                      | 400  | 498                      | 501  |
| 18                      | 24   | 426                      | 441  | 535                      | 536  |
| 18                      | 23   | 436                      | 452  | 494                      | 488  |
| 19                      | 28   | 348                      | 357  | 564                      | 564  |
| 21                      | 30   | 447                      | 455  | 606                      | 608  |
| 22                      | 32   | 504                      | 520  | 694                      | 695  |
| 22                      | 33   | 563                      | 569  | 749                      | 749  |
| 21                      | 32   | 507                      | 521  | 695                      | 695  |
| 21                      | 33   | 551                      | 585  | 780                      | 781  |



## BENCHMARK TESTS

percent on the 3D WinMark MMX test, while the Pentium MMX/233 was 60 percent better than the 6x86MX-PR233. Between the K6 and the 6x86MX, the AMD design was 32 percent better than Cyrix's PR equivalent. And at 233 MHz, the Pentium II was a 22 percent improvement over the Pentium MMX on the 3D WinMark MMX test.

Neither of the two tests exercises the CPUs with a comprehensive set of MMX instructions, but from all the data, we can extrapolate and make a good assessment of the CPUs' MMX capabilities. Both tests showed that the Pentium II is the best MMX processor by a wide margin over the next best, the Pentium MMX, whose dual-pipelined MMX architecture proved superior to that of AMD's K6, which processes one MMX instruction at a time. Cyrix's 6x86MX lagged all the MMX-capable CPUs.

### 3D WinMark 97

As faster 3-D accelerators relieve the CPU of more rendering tasks, they should reduce the CPU's contribution to 3D WinMark. True to this theory, the variance in scores attenuated as we went from no accelerator hardware to an average 3-D card (the Diamond Stealth 3D 2000XL using an S3 ViRGE chip) to an above-average 3-D card (Leadtek WinFast 3D L2200 with 3Dlabs' Permedia NT chip set, which includes the Glint Delta chip). More interestingly, we discovered that the 3-D performance of faster CPUs such as the Pentium II is actually slowed when they have to delegate 3-D rendering to average accelerators such as the Diamond 3D card. To verify the 3-D "deceleration" effect, we isolated the scores from scene 1, which is rendered completely in hardware, for both 3-D cards. Indeed, the Pentium II was faster when render-

ing in the emulation mode than with the Diamond card. Therefore, we recommend using only superior 3-D cards like Leadtek's if you have a Pentium II-based system. All other CPUs showed benefits when used with either of the 3-D accelerators. We did not test with dual CPUs because this benchmark test is not multi-threaded and does not take advantage of the second CPU.

### Floating-Point Tests

To test floating-point performance, which affects high-precision scientific calculations or complex graphics rendering, we used both a synthetic test (developed by Ed Henning of *PC Magazine UK*) and an application test (Photoshop 4.01 Lighting Effect filter). The synthetic test is not affected by memory size.

The two tests agreed except on the K6's performance relative to other CPUs. The K6 fared better than the classic Pentium in the Photoshop test, but worse in the synthetic test; the K6's internal architecture may allow it to perform better in memory-intensive operations (a component of the Photoshop test) compared with the classic Pentium. Intel's pipelined floating-point architecture proved superior to both AMD's and Cyrix's in all other cases. The Pentium/200 outscored the 6x86MX-PR233 on both tests and the Pentium II/233's score on the synthetic test was 72 percent better than that of the K6/233. The Pentium Pro also showed strong floating-point performance, outclassed only by that of the Pentium II.

### Pro/Engineer and AutoCAD

Along with the floating-point and Photoshop tests, the Pro/Engineer test and the AutoCAD test help us measure a CPU's suitability as a workstation processor. The Pentium II proved to be the best at

|                                                                                               | 3D TESTS (WIN 95, 32MB)    |                 |                  | MMX TESTS                                 |                                                   | FLOATING POINT TESTS                               |                                         | OTHER APPLICATIONS                                           |                                                |                                           |
|-----------------------------------------------------------------------------------------------|----------------------------|-----------------|------------------|-------------------------------------------|---------------------------------------------------|----------------------------------------------------|-----------------------------------------|--------------------------------------------------------------|------------------------------------------------|-------------------------------------------|
| ▲ Higher scores represent better performance.<br>▼ Lower scores represent better performance. | ZD 3D WinMark 97 Emulation | Diamond card* ▲ | Leadtek card** ▲ | ZD 3D WinMark 97 Emulation Win 95, 32MB ▲ | Photoshop Gaussian Blur Win NT, 128MB (seconds) ▼ | Photoshop Unsharpen Mask Win NT, 128MB (seconds) ▼ | Synthetic Floating Point Win NT, 32MB ▲ | Photoshop Lighting Effects Win NT, 128MB (minutes:seconds) ▼ | Pro/Engineer Win NT, 128MB (minutes:seconds) ▼ | AutoCAD Win NT, 128MB (minutes:seconds) ▼ |
| FIFTH-GENERATION CPUs                                                                         |                            |                 |                  |                                           |                                                   |                                                    |                                         |                                                              |                                                |                                           |
| AMD K5-PR166                                                                                  | 5.8                        | N/A             | N/A              | 5.8                                       | 24.2                                              | 22.1                                               | 379.7                                   | 2:58                                                         | N/A                                            | N/A                                       |
| Cyrix 6x86-PR200 ‡                                                                            | 3.4                        | N/A             | N/A              | 3.4                                       | 24.6                                              | 21.9                                               | 310.4                                   | 2:40                                                         | N/A                                            | N/A                                       |
| Intel Pentium/200                                                                             | 9.9                        | 19.8            | 54.5             | 9.9                                       | 21.3                                              | 20.4                                               | 733.6                                   | 1:58                                                         | 10:38                                          | 10:40                                     |
| Intel Pentium MMX/200                                                                         | 23.2                       | 24.4            | 58.4             | 23.2                                      | 18.5                                              | 5.4                                                | 758.8                                   | 1:44                                                         | 7:13                                           | 9:36                                      |
| Intel Pentium MMX/233                                                                         | 25.7                       | 26.1            | 62.1             | 25.7                                      | 15.0                                              | 4.9                                                | 872.3                                   | 1:31                                                         | 6:51                                           | 7:56                                      |
| SIXTH-GENERATION CPUs                                                                         |                            |                 |                  |                                           |                                                   |                                                    |                                         |                                                              |                                                |                                           |
| AMD K6/200                                                                                    | 18.6                       | 22.0            | 53.1             | 18.8                                      | 15.1                                              | 7.3                                                | 616.1                                   | 1:40                                                         | 8:43                                           | 7:47                                      |
| AMD K6/233                                                                                    | 21.2                       | 23.7            | 57.7             | 21.2                                      | 13.6                                              | 6.8                                                | 708.3                                   | 1:26                                                         | 8:17                                           | 7:16                                      |
| Cyrix 6x86MX-PR233                                                                            | 18.1                       | 18.6            | 45.1             | 18.1                                      | 17.6                                              | 7.6                                                | 425.2                                   | 2:01                                                         | 8:49                                           | 8:11                                      |
| Intel Pentium Pro/200                                                                         | 10.5                       | 22.1            | 62.6             | 10.5                                      | 11.6                                              | 12.7                                               | 960.1                                   | 1:24                                                         | 5:49                                           | 6:04                                      |
| Intel Pentium II/233                                                                          | 31.5                       | 29.7            | 70.0             | 31.5                                      | 8.1                                               | 4.6                                                | 1,217.2                                 | 1:13                                                         | 5:12                                           | 5:11                                      |
| Intel Pentium II/266                                                                          | 34.9                       | 30.9            | 73.5             | 34.9                                      | 7.5                                               | 4.1                                                | 1,328.0                                 | 1:03                                                         | 4:51                                           | 4:44                                      |
| Intel Pentium II/300                                                                          | 37.5                       | 32.4            | 75.8             | 37.5                                      | 6.9                                               | 3.8                                                | 1,562.5                                 | 0:57                                                         | 4:39                                           | 4:31                                      |
| DUAL-PROCESSOR PENTIUM II                                                                     |                            |                 |                  |                                           |                                                   |                                                    |                                         |                                                              |                                                |                                           |
| Dual Intel Pentium II/266                                                                     | 34.1                       | N/A             | N/A              | 34.1                                      | 5.0                                               | 2.8                                                | 1,388.8                                 | 1:04                                                         | 4:55                                           | 4:44                                      |
| Dual Intel Pentium II/300                                                                     | 37.1                       | N/A             | N/A              | 37.1                                      | 4.9                                               | 2.6                                                | 1,564.1                                 | 0:58                                                         | 4:37                                           | 4:22                                      |

N/A—Not applicable. We did not run this test with this configuration. \* Tested with hardware 3-D support through the Diamond Stealth 3D 2000XL graphics card.

\*\* Tested with hardware 3-D support through the Leadtek WinFast 3D L2200 graphics card. ‡ Cyrix considers this a sixth-generation CPU, but the chip is positioned against Pentium-class processors.

## PAGEWORKS 20 &amp; 12

**PAGEWORKS #1**



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## BENCHMARK TESTS

running the workstation software, followed by the Pentium Pro. The Cyrix 6x86MX-PR233 surpassed AMD's K6/233 in running the AutoCAD script and came close to doing the same in processing the Pro/Engineer Trail File. The Cyrix chip's faster 75-MHz bus (the AMD has a 66-MHz bus) and its dynamically allocated L1 cache may have contributed to this result.—*Analysis written by S. Jae Yang*

## How We Tested

We used machines with identical subsystem hardware in order to isolate CPU performance. Each unit had EDO memory, an IBM 5GB EIDE hard disk, and a Diamond Stealth 3D 2000XL graphics adapter. We set the L2 cache to 512K, except for the Pentium Pro, which has 256K of L2 cache embedded on the chip. We tested under two operating systems, Microsoft Windows 95 with OSR 2 and Windows NT 4.0 with SP 2. We did not use a common motherboard with all the CPUs, however, because no single motherboard supports all the processors we tested and because motherboards are often tuned to specific CPUs before being sold. We performed all tests with the display set to 1,024-by-768 resolution with 65,536 colors, except for ZD High-End Winstone 97, AutoCAD, and Pro/Engineer, which we ran at 1,024-by-768 with 16.7 million colors.

We used our ZD Winstone 97, Version 1.0, benchmark test suite to measure the machines' performance when running 32-bit Windows applications. Winstone 97 is divided into two categories: ZD Business Winstone 97 and ZD High-End Winstone 97. Business Winstone measures the time a PC takes to execute a set of application scripts that use eight of the best-selling Windows 95 applications. Business Winstone weights a given PC's test timings based on the applications' unit market shares; it derives a composite number and converts it to a relative score. (The score is relative to the performance of a Gateway 486DX2/66 with 16MB of RAM, whose score is defined as 10.) High-End Winstone 97 measures the time it takes for a system to execute a set of application scripts that exercise six 32-bit Windows applications in four categories: CAD, application development, image editing, and 3-D visualization. High-End Winstone weights a given machine's performance on the six tests equally, then derives a composite number and converts it to a relative score. (The score is relative to the performance of a Dell Pentium/100 system with 32MB of RAM, whose score is defined as 10.)

The ZD CPUmark<sub>16</sub> and ZD CPUmark<sub>32</sub> scores reflect the speed of a PC's processor subsystem—which includes the CPU, secondary cache, and system RAM—under 16- and 32-bit operating systems, respectively.

We used ZD 3D WinMark 97, based on Direct3D, to evaluate the MMX performance of CPUs as well as 3-D rendering capabilities at various levels of 3-D hardware acceleration. The test suite exercises the 3-D subsystem with ten scenes that summon various rendering features. The test results are scaled to the performance of a base system (a 200-MHz Pentium-based PC with no 3-D accelerator hardware) whose score is defined as 10.

To measure the MMX performance, we set the testing parameters to engage the MMX DLL and force all 3-D rendering to be executed by the CPU using Direct3D's emulation library. To study the CPU's relation to 3-D accelerator hardware, we tested with two 3-D cards: an average one (Diamond Stealth 3D 2000XL using the S3 ViRGE chip set) and an above-average model (Leadtek WinFast 3D L2200 using 3Dlabs Permedia NT). We ran the 3D WinMark suite of tests only under Windows 95 with 32MB of memory, a common configuration for Direct3D games.

Various filters in Adobe Photoshop 4.01 were used to test MMX and floating-point performance. We used the Gaussian Blur and

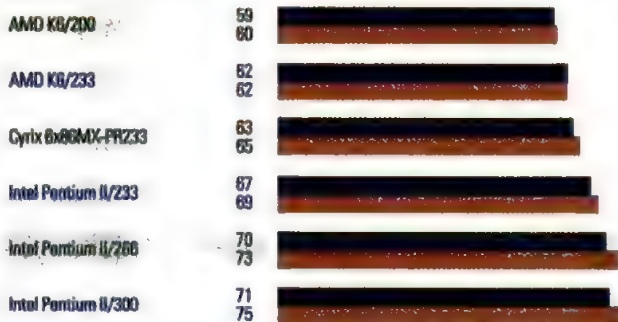
## ZD Business Winstone 97: IDE vs. SCSI

■ IDE ■ SCSI

### 5TH-GENERATION CPUs



### 6TH-GENERATION CPUs



BETTER ▶

Tested with Windows NT, 64MB RAM, and a 5,400-rpm IDE drive or a 10,000-rpm SCSI disk.

Unsharpen Mask filters to evaluate MMX processing, and the Lighting Effects filter as a floating-point test. We used a 15MB image for all tests. The Gaussian Blur filter was applied with the radius value at 10; for Unsharpen Mask we used a radius of 1.0. We ran the Photoshop tests under Windows NT 4.0 with 128MB of RAM to minimize hard disk activity and because this is the typical workstation configuration. We used Photoshop's internal timer to measure the elapsed time for all tests.

PC Magazine UK's Ed Henning developed our floating-point test, which consists of five algorithms to solve Poisson's equation, fast Fourier transform (FFT), calculation of planetary orbitals, calculation of areas of polygons, and Gauss-Jordan elimination of coefficient matrix of linear equations. The algorithms are weighted to reflect real-world usage and reported as one score. As the test is memory- and OS-independent in terms of relative performance, we ran it only under the Windows NT/32MB configuration.

Pro/Engineer, from Parametric Technology Corp., allows users to design objects or products from beginning to end. Parametric Technology created the Trail File test (similar to a macro that automates functions), which designs a fishing reel. The test included parts design, assembly, multiple 2-D views, and 3-D rendering operations. The test—which uses both integer and floating-point math—heavily stresses CPU and memory operations. We used a single number representing the time that it took for each unit to execute the entire Trail File test from start to finish as the performance measure. Although Pro/Engineer is typically used with an OpenGL accelerator, we deliberately used a non-OpenGL graphics card, the Diamond Stealth 3D 2000XL, to further stress the CPUs' capabilities.

Our AutoCAD test combines AutoCAD script files and AutoLISP subroutines. Three functional areas are tested: opening 2-D and 3-D drawing files; performing 2-D manipulations such as new-entity additions, entity deletions, zooms, and pans; and 3-D manipulations, which combine 3-D view rotations and alterations, 3-D move operations, and a variety of rendering tasks. CPU, disk, and graphics subsystems are all heavily stressed. The tests use the Autodesk WHIP driver and accelerate Autodesk's Heidi API calls instead of OpenGL calls. Our single result reflects the time each machine took to execute all scripts.

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**PC Computing, 4/97**

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Source: PC Computing Benchmarks

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|-------------------------------------|-----------|
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| Compaq, Gateway 2000, Micron, NEC   | Good      |
| Acer, AST, Toshiba                  | Fair      |
| AT&T, Digital, Packard Bell         | Poor      |

**Windows Magazine, 2/97**



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as A.B.C.D.E.F.G.

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|-----------------|--------------------------------|
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| <b>Quantex</b>  | <b>91%</b>                     |
| Hewlett-Packard | 89%                            |
| IBM             | 89%                            |
| Micron          | 81%                            |
| Gateway         | 80%                            |
| Acer            | 74%                            |
| AST             | 74%                            |
| NEC             | 71%                            |
| ATI T           | 69%                            |
| Digital         | 69%                            |
| Toshiba         | 61%                            |
| Compaq          | 58%                            |
| Packard Bell    | 51%                            |

Windows Magazine, 8/97

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uses a 75MHz bus in its 6x86MX-PR233, and both AMD and Cyrix will move to 83 or 100 MHz bus speeds for some future CPUs. This pushes the limits of what can be achieved with the Socket 7 bus, and chip set design at these speeds will be difficult. Note that even at 100 MHz, the system bus would be slower than the L2 cache bus in the slowest Pentium II system. Intel plans to move to a 100-MHz system bus for the Pentium II in 1998, and the Pentium II's L2 cache speeds will exceed 150 MHz.

The midterm solution for AMD, Cyrix, and other x86 contenders is to integrate the L2 cache on the processor chip. In 1998, at least two processors are likely to be available that put a 256K L2 cache on-chip. This cache will have its own private bus to the processor—just like a Pentium II cartridge—and everything will be on a single

make it more practical to store memory-intensive 3-D texture maps in main memory, instead of requiring additional memory as part of the graphics subsystem. AGP in essence is an enhanced version of PCI that supports much higher transfer speeds. It allows only a single device to be connected, however, so it supplements, and does not replace, PCI.

To promote the transition to Slot 1, Intel does not plan to support AGP in its Pentium chip sets or motherboards. This presents Cyrix and AMD with a new challenge: Today, Intel chip sets predominate—even in systems using Cyrix and AMD CPUs. To move into the AGP era, system designers will have to depend on non-Intel chip sets to accompany non-Intel CPUs.

Several chip set makers have committed to producing AGP chip sets for Socket 7 processors. Implementing AGP is complex, however, and it remains to be seen whether these chip sets will deliver performance comparable to Intel's LX chip set for Pentium II systems. To help ensure that competitive AGP chips sets are available for the K6, AMD has gone into the chip set business itself. AGP chip sets from Intel and others are due this fall.

### 3-D AND MULTIMEDIA ACCELERATION

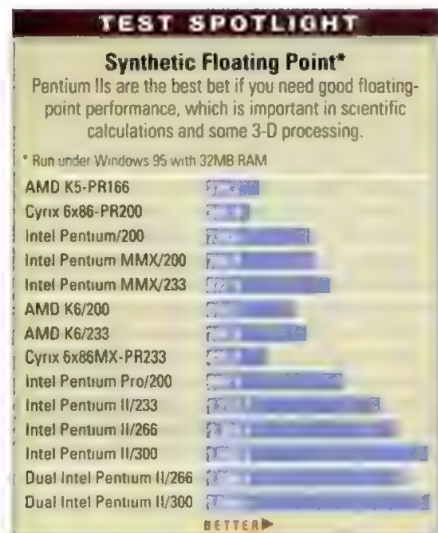
Many of today's PC applications don't require greater processor performance; they run perfectly well on a Pentium/133. Many of the most demanding applications are those that use 3-D graphics or video, and these applications can be enhanced—within limits—by hardware accelerators.

For 3-D graphics, functions can be divided between the processor and the graphics accelerator in many ways. With a simple, 2-D-oriented graphics controller, all the 3-D functions are handled in software; part of Microsoft's Direct3D software is an emulation library that performs all the required functions, using MMX if available. With most of today's 3-D accelerators, the rendering function—drawing filled triangles on the screen—is handled in the accelerator, while the geometry function—manipulating the 3-D image's mathematical model to produce a set of 2-D triangles—is done by the host CPU. Geometry processing generally requires floating-point computations, so CPUs with good FP performance do best on this task (see chart, left).

In our tests, the benefits of MMX show

up clearly when performing 3-D rendering in software. Once a good 3-D accelerator is added, though, the usefulness of MMX for 3-D evaporates, so the Pentium Pro, for example, provides nearly the same performance as the Pentium II (see chart, below). The slow floating-point execution of the Cyrix and AMD parts results in lower 3-D performance even when a good 3-D accelerator is used, however.

To make the most of your money, consider buying a slightly slower CPU and spending the savings on MPEG or 3-D accelerators. These accelerators won't help performance on applications that don't use these functions, of course, but they can provide a much bigger boost in 3-D and video performance than you would get from moving up one speed grade in a processor line. A \$100 CPU with \$500 in



piece of silicon. This technique should keep Socket 7 systems viable, except at the high end of the market, through 1998.

In time, however, Intel's competitors will have to move to a new bus design. They might produce CPUs compatible with Slot 1 (or its successor) in 1999, or they may move to a completely new bus design.

### AGP ADDS A TWIST

The biggest change in PC system architecture this year will be the arrival of the Advanced Graphics Port. AGP provides a separate, dedicated connection for the graphics controller, enabling the processor to send commands to the graphics chip faster and allowing the graphics controller to transfer data from main memory at a much higher rate. This latter feature will



graphics hardware could yield a better multimedia system than a \$500 processor with \$100 in graphics hardware—though this is not, as you may imagine, the way the processor vendors want you to think.

Be careful not to mate a fast host CPU with a slow 3-D accelerator. With a Pentium II, for example, the mainstream 3-D



## New Low-Cost MMX Alternative from IDT

By Michael Slater

**I**ntegrated Device Technology (IDT) is a newcomer to the x86 processor business. An IDT subsidiary, Centaur Technology, has developed a low-power, low-cost CPU called the IDT-C6. Early samples have been shipped to key prospects, but systems using this chip won't appear until this fall.

The IDT-C6 is a single-issue, non-superscalar design like the 486. But by using a Pentium bus, a large on-chip cache, and a refined pipeline design, it

can achieve Pentium-level performance. Like the K6 and 6x86MX, it has 64K of on-chip cache, it is Pentium pin-compatible, and it implements the MMX extensions. Its die size (88 square millimeters) is considerably smaller than that of its competitors, reducing manufacturing costs, and IDT plans to price it aggressively. First models will appear in 150- to 200-MHz varieties.

One advantage of the IDT-C6's streamlined design is its low power consumption; IDT hopes to find a

market in portable systems as well as in desktops. The chip's biggest weakness, like the K6 and 6x86MX, is its FP and MMX performance.

Unlike AMD and Cyrix, IDT is not out to capture 10 percent or more of the market—it will be quite happy with just a few percent. The IDT-C6 will probably show up primarily in systems from smaller Asian manufacturers; it has a good chance to be the least expensive MMX processor in the near future.

card used in the tests actually acted as a "decelerator"—it delivered a lower 3-D WinMark score when its acceleration functions were enabled. This is because the Pentium II, using the Direct3D emulation code with MMX, was able to render faster than the hardware. The high-end 3-D card did provide a performance boost, however, even with the fastest Pentium II.

The most advanced 3-D accelerators have fast FP engines to handle geometry processing as well as rendering. Today these chips are used primarily in CAD applications, generally using the OpenGL API. Geometry acceleration isn't supported in the way most games are written, using Direct3D or other game-oriented APIs. In the next year or so, lower-cost 3-D chips with geometry acceleration will appear, and the Direct3D API will evolve to support such accelerators more readily. Once these technologies are widely available and games are modified to take advantage of them, the FP performance of the host CPU may become unimportant for 3-D. A lot of software needs to change before this will be the case, however. Furthermore, if the 3-D chip takes over geometry processing but doesn't have faster FP execution than the host CPU, the "deceleration" phenomenon seen with the Pentium II and today's mainstream 3-D accelerators could recur.

### FUTURE ROAD MAPS

In the microprocessor business, no vendor can afford to stand still for long—all of today's hot chips will be mundane, entry-level or midrange devices within a year or two. Earlier this year, the Pen-

tium/133 was the entry-level product; now it is the Pentium/166, and by the end of the year it will be the Pentium MMX/200.

Intel isn't likely to add any new chips in the Pentium or Pentium MMX lines beyond Tillamook; its focus will be on Pentium II and its successors. Due early next year is a version of Pentium II, code-named Deschutes, which uses the 0.25-micron process technology. This will be the first P6-family CPU with power consumption low enough for notebook systems. It will also enable clock speeds of 300 to 400 MHz. When the Deschutes-based Pentium II processors come out, today's versions will move down to mainstream prices. Deschutes-based cartridges will support four-processor systems and probably will be available with larger L2 caches, making them attractive for servers and, over time, making the Pentium Pro obsolete.

A chip code-named Katmai is rumored to be due by the end of 1998 and to include larger L1 caches and an enhanced version of MMX. These MMX2 features are likely to be further extensions to the instruction set, retaining compatibility with MMX but adding features such as the ability to do two floating-point operations per clock cycle for 3-D geometry calculations.

In 1999, Intel is expected to have a next-generation x86 processor, code-named Willamette, and its first IA-64 processor, code-named Merced. The IA-64 processors will implement a new, 64-bit instruction-set architecture that promises to boost performance over x86 processors dramatically, especially for floating-point

functions. Achieving this boost, however, will require new software compiled for the 64-bit instruction set. IA-64 processors will also fully implement the x86 architecture (now called IA-32), so they can run all existing PC programs—but without a performance advantage.

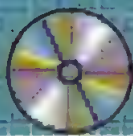
At least initially, Merced will be aimed at workstations and servers, not at PCs, so the x86 processor line will continue to dominate the PC market for quite some time. Future IA-64 processors are likely to move into the PC market, but this eventuality is at least five years away.

AMD and Cyrix will continue ratcheting up the clock speed of their processors. Both companies plan to move to 0.25 micron-process technology by the end of this year. Next year, both companies are likely to seek ways to add L2 cache to their CPUs, bypassing the biggest limitation of the Socket 7 pinout. Both are also likely to make modifications to their CPUs to enhance their lackluster MMX and FP performance. (These new chips will be disclosed for the first time at the Microprocessor Forum in October; for more information, see [www.mdronline.com/mpf](http://www.mdronline.com/mpf).)

In 1999, AMD and Cyrix should each have another generation of processors ready—the K7 from AMD, and the M3 from Cyrix—but the companies have revealed nothing of substance about these designs. It is unlikely they will be able to leap ahead of Intel's high-end processors, but they will probably be able to maintain their current position of providing good, economical alternatives to Intel's mainstream and entry-level processors. **PC**



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# NETWORK

*in a*

BY STEVE RIGNEY

# BOX

*Network kits provide all you need to create a small-office network out of two or three PCs.*

*But how easy are they to install?*

One of the biggest growth areas in networking today is the small-office network. Businesses with anywhere from 2 to 50 users are finding that it makes the same economic sense for them to share files, printers, modems, and other resources as it does for larger companies. Even some homes with more than one PC and several peripherals are starting to build home office networks. Networking vendors big and small are responding with small-office networking products that provide many of the features and functions of their corporate counterparts, but in small-footprint packages that are affordable and easy to install.

For this roundup we tested eight small-office networking kits. Each kit comes

[www.pcmag.com](http://www.pcmag.com)

Join contributing editor Steve Rigney, senior networking editor Frank Derfler, Jr., and senior editor Leon Erlanger online for a discussion of small office networking.



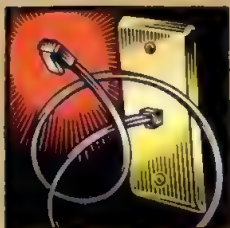
# Five Steps to a Small-Office Network

*The process of building a small-office network can be broken down into five basic steps. Make sure you plan your present network with future growth in mind.*



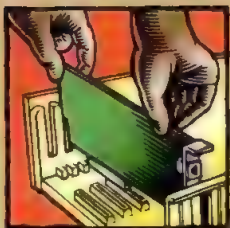
## Plan ahead.

- Decide beforehand which files and resources you want to share and who should have access to each resource down to the subdirectory level.
- Make sure that an extra slot is available in each PC for the type of network card (ISA or PCI) you plan to use.
- If you're connecting more than two or three machines, get an office layout to help you estimate cable lengths.
- Place shared printers in a location where they will not disturb those working nearby.



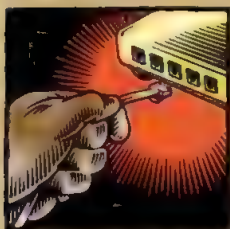
## Install the cable.

- If you plan to connect only two or three computers that will be very close together, you can run cables along the floor and behind desks.
- Keep cables away from areas where people walk.
- Keep the cables at 90-degree angles to power cords to prevent interference.
- If you expect eventually to have more than a few PCs in one location, use Category 5 cables and hubs.



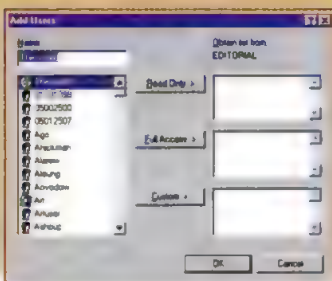
## Install network interface card in each PC.

- Use PCI adapters; if you must use ISA adapters, use ones that support Plug and Play.
- Turn off the PC and disconnect the power cord before installing the card.
- Touch grounded metal to discharge static electricity before handling the card.
- Before you install the drivers, test the configuration settings using the installation software to make sure there are no conflicts.



## Connect the cables to the hub.

- Place the hub in a central location. In larger offices, use the phone room or wiring closet. In smaller offices, put the hub on a desk or mount it on the wall.
- Plug each cable into ports on the hub and the NIC.
- Connect the hub to an uninterruptible power supply (UPS).
- Plug in the hub power supply and flip the on/off switch to On.



## Configure the NOS.

- Follow the NOS documentation to set up shared drives, directories, printers, and so forth, as well as user privileges.
- Pick your protocols. Use IPX across the LAN and stay away from installing TCP/IP if you don't need it.

with at least two Ethernet network adapter cards, a hub, and cabling—all you need to connect at least two PCs together physically in an Ethernet LAN. These network starter kits are packaged for the home- or small-office user and can be found in computer and other retail stores or via mail order. The kits we tested came from Dayna Communications, D-Link Systems, Hewlett-Packard Co., Linksys, NDC Communications, NetGear, and 3Com Corp.

PC Magazine Labs put all the kits through their paces, setting up small LANs and sharing files, printers, and other resources. Unlike most of the networking products we usually review, however, network kits are aimed at an audience that includes many network novices. So we took a very careful look at the warranties, documentation, and technical support provided by the vendors. Then we brought a group of actual network novices into PC Labs and challenged each of them to set up a small network using one of these products. The results were mixed. All of our participants succeeded in setting up the hardware, but most felt abandoned by the kit vendors when it came to configuring Microsoft Windows 95 for sharing files and other resources. (For more information, see the sidebar "User Testing: Getting That Net to Work.")

## WHY NETWORK?

Everyone knows that the cost of hardware, particularly hard disk storage, has been falling rapidly for the past several

## IN THIS REVIEW

|                                                           |     |
|-----------------------------------------------------------|-----|
| Dayna Network Starter Kits .....                          | 174 |
| D-Link Network Kit.....                                   | 180 |
| Hewlett-Packard Network Kit.....                          | 185 |
| Linksys Instant Ethernet Series Network Starter Kit ..... | 186 |
| NDC SOHware Network Personal Starter Kit .....            | 191 |
| NetGear Network Starter Kit.....                          | 191 |
| 3Com OfficeConnect Networking Kit.....                    | 195 |
| Editors' Choice .....                                     | 169 |
| Network Operating Systems for the Small Office .....      | 170 |
| Small-Office Networking Glossary .....                    | 174 |
| Summary of Features .....                                 | 176 |
| Hub + Router Does It All.....                             | 184 |
| User Testing: Getting That Net to Work .....              | 192 |
| And Then There Are the Cables.....                        | 193 |



years. Now that you can get a 5GB hard disk for only \$500, why bother taking the time and expense to set up a small network for sharing hard disks?

Actually, in many cases sharing still makes economic sense. For example, rather than buying a printer for each PC, you can save money by purchasing one printer and letting several people on the network use it. And since you're only purchasing one printer instead of two or three, you can probably afford a better printer. The same goes for CD-ROM drives, modems, and other peripherals.

It also makes practical sense. Anyone who has collaborated on a project knows how difficult it can be to keep track of document versions when members of the team are constantly exchanging floppy disks and each member has a copy of the same file on his or her hard disk. Connecting PCs allows everyone to work on the same file on the same hard disk, and it allows you to centralize important tasks such as backup.

In a growing office, networking also allows you to take advantage of the increasing number of network applications, such as e-mail, contact managers, and databases.

Finally, networking PCs in a home or small office is easier and more affordable than ever before. Most PCs today come with Windows 95, which can easily be configured to share files and other resources in a peer-to-peer network in which each system can serve an individual user and share files with other users at the same time. There are also other operating systems for networking small offices on the market (see the sidebar "Network Operating Systems for the Small Office").

While the networking kits in this roundup are not free, they are inexpensive. Most have list prices under \$200. The NDC SOHware Network Personal Starter Kit sells for less than \$100 on the street. The most expensive kit, Hewlett-Packard's Network Kit, is priced at \$499 list, and 3Com's OfficeConnect Networking Kit goes for \$339 list. The higher-priced kits come with three adapter cards and cables and provide hubs with eight ports. Each PC needs to be connected to a single port on the hub, so if

## Editors' Choice

- Instant Ethernet Series Network Starter Kit
- 3Com OfficeConnect Networking Kit



*All the kits we tested were relatively easy to install and worked the way they should. We were hard-pressed, however, to find the perfect combination of*

low pricing, quality hardware, excellent documentation, and generous technical support. We hoped to find that elusive combination from a vendor that offers a complete line of small-office networking products to supplement its kit.

In the end, we decided that the kits from Linksys and 3Com came the closest. At a street price of \$130 for two adapters, a five-port hub, and cabling, Linksys offers one of the least expensive kits we tested. While the included documentation could have used a few more diagrams, it offers clear, step-by-step instructions for setting up your small-office LAN. Unlike many of the other products' documentation, it even takes the next step of telling you how to configure Windows 95 for sharing resources. Apart from Hewlett-Pack-

ard and NetGear, Linksys was the only vendor to offer free technical support on Saturdays. And Linksys also offers a full line of small-office networking products.

For growing small offices, we choose the 3Com OfficeConnect Networking Kit, which comes with three adapters, an eight-port hub, and a generous amount of cabling. Its \$300 street price is not cheap, but for the price you get more hardware and the best documentation we saw, including worksheets to help you plan your network installation and instructions for setting up the kit with many different operating systems. 3Com is a top-tier networking vendor that offers just about any network device you could possibly want.

Honorable mentions go to HP and NetGear for 24-hour, 7-day technical support and excellent documentation.

you want to connect eight PCs, you'll have to purchase five additional cards and cables. These three-card, eight-port kits are appropriate for small offices that are expected to grow in the near future.

The kits that sell for under \$200—Dayna's Home Office Network Starter Kit, the D-Link Network Kit, Linksys's Instant Ethernet Series Network Starter Kit, NDC's SOHware Network Personal Starter Kit, and the NetGear Network Starter Kit—come with two cards, two cables, and hubs with either four or five ports. These are most appropriate for home or small offices that will stay close to the same size they are today. You can always purchase and connect another Ether-

net hub and more Ethernet cards and cables, either from the same vendor that sold you your kit or from another vendor, since all this equipment adheres to the same standards. But keep in mind that Ethernet only allows four hubs per LAN segment, so it makes sense to get a bigger hub now if you intend to grow in the future.

### HOW EASY IS IT?

Setting up a small network for sharing files and peripherals under Windows 95 should be a relatively easy undertaking, especially since all of the network interface cards we tested are Plug and Play-compatible. Nobody, not even a novice, should have to hire a consultant to connect two or three PCs together. That's why we examined the vendors' documentation and technical support.

Fortunately all of the kits came with documentation that was at least adequate, with step-by-step instructions for getting

**Our Contributors:** PADRAIC BOYLE, TONY POMPILI, and STEVE RIGNEY are contributing editors of *PC Magazine*. FRANK J. DERFLER, JR., is the senior networking editor of *PC Magazine*. LEON ERLANGER was the senior editor in charge of this story, and JEFFREY G. WITT was the project leader.



## Network Operating Systems for the Small Office

The most obvious item missing from our main roundup is software for the network operating system (NOS). Several of these packages, including those from Linksys and NDC Communications, are designed to work especially with Microsoft Windows 95. But by opting to exclude any NOS software, the vendors provide you with the flexibility to use whatever network suits your needs. We look at the most popular small-office NOSs, including Artisoft's LANtastic, Microsoft Windows NT Workstation, Windows 95, and Novell's IntranetWare for Small Business.

### MICROSOFT WINDOWS 95/WINDOWS NT

Loaded on most new PCs, Microsoft Windows 95 is a popular small-office NOS. You can use it to share printers, CD-ROM drives, and even the data stored on your local hard disks. Windows 95 also includes client software that lets you connect to other NOSs. Unfortunately, Microsoft (800-426-9400; [www.microsoft.com](http://www.microsoft.com)) doesn't offer any client software for DOS-based PCs, so Windows 95 is a useful NOS only if all your clients and servers are running Windows 3.11 or later.

The next level up, Windows NT Workstation includes everything you need to set up a peer-to-peer network for up to ten users. But Windows NT Workstation is not bundled on most PCs; expect to pay about \$300 per copy. Unlike Windows 95, this NOS includes several Internet/intranet utilities, including Web, FTP, and Gopher servers. Unless you want the extra utilities, Windows 95 should work fine as a NOS for two to seven PCs; after that, you should consider upgrading your server to Windows NT Workstation. Windows 95's backward-compatibility with legacy 16-bit applications may be a better fit for older small offices.

### LANTASTIC

One of the oldest small-office NOSs still on the market, LANtastic 7.0

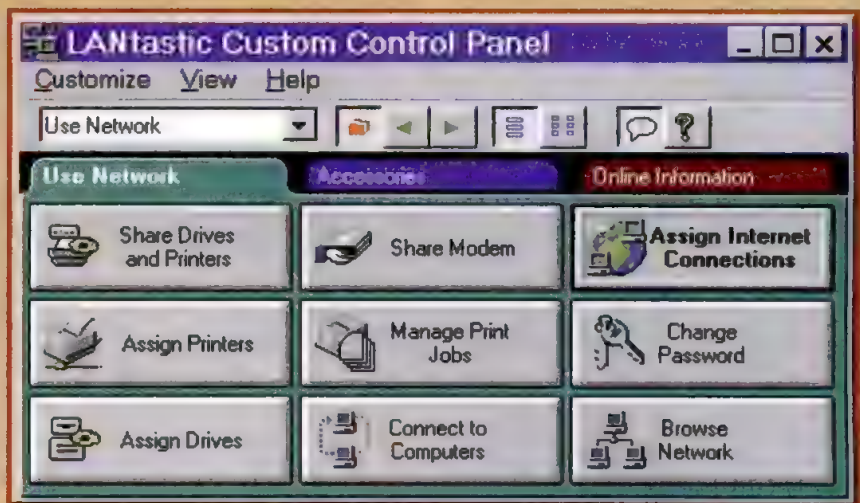
(\$499 list, for a two-to-ten-user license), from Artisoft (800-846-9726; [www.artisoft.com](http://www.artisoft.com)), is ideal if you want to have DOS-based systems on your network. LANtastic includes all of the software needed to connect your DOS, Windows 3.x, and Windows 95 PCs together. Artisoft has recently introduced a version for Windows NT.

Among our favorite features of LANtastic is its built-in modem-sharing utility called i.Share. With it, you can share a single dial-up or dedicated Internet connection with all the users on your network.

The CoSession remote-control software is another utility bundled with LANtastic. With CoSession, you can receive remote technical support from Artisoft if you have any problems. Given its solid performance and

intranetware) called IntranetWare for Small Business (\$895 list, for five-user license and five simultaneous connections). It still operates with a dedicated PC as a server. Though the technicians at Novell claim that IntranetWare is easy to install, the product does require you to set up special hard-disk partitions and may seem confusing to the novice. This version uses the same code as the other Novell products in that category but lacks their IPX-to-IP gateway and Multi-protocol Router. It does add some new features, such as a remote node server for connecting from a remote location and a new graphical network-management utility similar to Windows 95 Dial-Up Networking.

The remote node server, NetWare Connect, is also available as a stand-alone product for other versions of



LANtastic's Control Panel lets you configure all your networking tasks from a single screen.

all of these features, LANtastic is a worthwhile choice for a small network ranging from 2 to 50 nodes.

### INTRANETWARE

Novell's NetWare and IntranetWare are usually considered high-end NOSs for larger networks of a dozen or more PCs. But there is a new, scaled-down version of the NOS from Novell (800-453-1267; [www.novell.com/](http://www.novell.com/)

NetWare and IntranetWare. The new client software is called Novell Easy Administration Tool (NEAT), and it's a lot easier to use than the standard NetWare Administrator found in the other versions. A helpful feature of the small-business version is its ability to add licenses on a per-user basis. With the other versions, you must purchase license packs in quantities of five or more.—SR

**Better  
Cost Control**



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## NETWORKING

### Network in a Box

the included hardware to work. The 3Com kit provides the best information, with useful diagrams and clear definitions of networking terms. It also offers worksheets you can use to keep track of the steps on the installation. Hewlett-Packard also provides excellent documentation.

The sparsest documentation came from D-Link and NDC, but despite a lack of diagrams and definitions, each provided relatively clear instructions for setting up the hardware and installing drivers for the network interface cards. The manuals from Dayna, D-Link, and NDC abandon the user after the hardware is installed, leaving you to look for your operating system manuals to figure out how to set up your OS for sharing files and other resources.

Since these kits are aimed at small- and

home-office users, many of whom will be installing these kits after business hours, we looked for generous free telephone technical-support hours, particularly after normal work hours and on weekends. We were surprised to find that only HP and NetGear offer 24-hour, 7-day toll-free support. The others offer support after hours on weekdays, and Linksys has support hours on Saturdays. We had generally positive experiences calling all the technical-support numbers and asking questions.

3Com offers unlimited lifetime warranties on all of the components in the kit. NetGear offers lifetime warranties on all of the hardware, except the power supply for the hub—unfortunate, since that's a very important piece of the network. The shortest warranty period is the five years offered

by Linksys, but five years is a long time when it comes to networking technology.

### NETWORK ADAPTERS

Before you purchase a network kit, you have to decide whether you want ISA or PCI network adapters. While PCI tends to be faster, a typical small network will get perfectly adequate performance with either type of adapter, so the choice really depends on what types of slots—ISA or PCI—are free in your PCs. All of the adapters that we tested, both ISA and PCI, work with Windows 95 Plug and Play, and all installed relatively easily.

The kits from D-Link, NDC, and 3Com come with ISA adapters. Those from HP, Linksys, and NetGear come with PCI. Dayna offers kits with either type of

## Thumbs Up, Thumbs Down: Small-Office Network Kits

*While all of the network kits we tested proved easy to install and configure, some came with features and documentation that were either clearly superior or could have used improvement.*



**3COM** offers excellent documentation, with worksheets you fill out to keep track of your network.

**Network Checklist** Make sure you've checked the purpose of your network. You probably have an idea what you want to do. Take a few minutes and use Table 2.1 to see how the components you want to use fit the network, and the features of some devices you might find in a network.

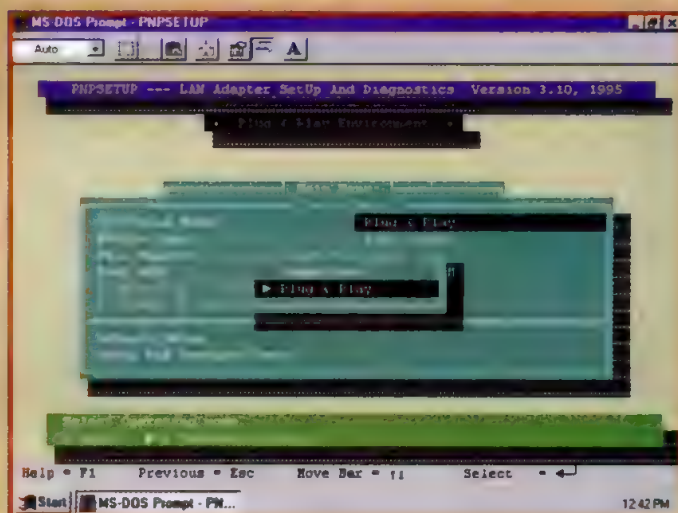
**Table 2.1 Network Configuration Checklist**

| Component | Name        | Description            | Put on the network? | Use as a server? If so, for what? | Primary user name |
|-----------|-------------|------------------------|---------------------|-----------------------------------|-------------------|
| PC 1      | SALES       | PC in Sales            | Y                   | No                                | John              |
| PC 2      | MARKETING   | PC in Marketing        | Y                   | No                                | Jennifer          |
| SERVER 1  | SERVER 1    | Server for Sales, Mktg | Y                   | File/print                        | N/A               |
| PC 3      | ENGINEERING | PC in Engineering      | Y                   | No                                | Fred              |
| SERVER 2  | SERVER 2    | Server for Engineering | Y                   | File/print                        | N/A               |
| PC 4      | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 5      | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 6      | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 7      | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 8      | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 9      | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 10     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 11     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 12     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 13     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 14     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 15     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 16     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 17     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 18     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 19     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 20     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 21     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 22     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 23     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 24     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 25     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 26     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 27     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 28     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 29     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 30     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 31     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 32     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 33     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 34     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 35     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 36     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 37     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 38     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 39     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 40     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 41     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 42     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 43     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 44     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 45     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 46     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 47     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 48     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 49     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 50     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 51     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 52     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 53     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 54     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 55     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 56     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 57     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 58     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 59     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 60     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 61     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 62     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 63     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 64     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 65     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 66     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 67     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 68     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 69     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 70     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 71     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 72     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 73     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 74     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 75     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 76     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 77     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 78     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 79     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 80     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 81     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 82     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 83     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 84     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 85     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 86     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 87     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 88     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 89     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 90     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 91     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 92     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 93     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 94     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 95     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 96     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 97     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 98     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 99     | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |
| PC 100    | ACCOUNTING  | PC in Accounting       | Y                   | No                                | N/A               |

**LINKSYS'S** hub has an uplink port that automatically crosses the cable without making you flip a switch or purchase a crossover cable.



**PLUG AND PLAY** doesn't recognize Dayna's adapter cards unless you switch them out of their default mode.





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133-MHz Intel® Pentium® processor with optional MMX™ technology  
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**GLOSSARY**

## Small-Office Networking Glossary

**BNC connector** A connector commonly found with coaxial cable.

**Collision** The loss of electronic signals, or packets, that results when two workstations attempt to transmit data simultaneously across a shared medium. Data must be resent as a consequence.

**Crossover cable** A type of networking cable in which some wires are reversed from one end to the other to join two computers or two hubs.

**Ethernet** A LAN cable-and-access protocol that uses twisted-pair or coaxial cables and CSMA/CD (Carrier Sense Multiple Access with Collision Detection), a method for sharing devices over a common medium. *Ethernet* runs at 10 Mbps; *Fast Ethernet* runs at 100 Mbps.

**Full-duplex** Using simultaneous two-way communication between network cards, which effectively doubles the available bandwidth from 10 to 20

Mbps in Ethernet or from 100 to 200 Mbps in Fast Ethernet.

**Hub** A hardware device that serves as the junction where individual PCs and other network devices connect to each other. Up to four hubs can be connected per LAN segment to increase the number of available ports.

**LAN** Local area network; a communications network that links PCs and other devices in a single office or small campus. In *client/server LANs*, users' PCs (the clients) access shared files and sometimes applications stored on a dedicated PC that acts as the server. In *peer-to-peer networks*, any connected PC can serve as both a client and a server.

**NDIS** Network Driver Interface Specification; a hardware- and protocol-independent driver specification for network adapter cards developed by Microsoft and 3Com and supported by many NIC vendors and OSs.

**NIC** Network interface card; another name for the adapter card that goes into your PC and connects it to a LAN.

**ODI** Novell's Open Data-link Interface, a device driver specification for network adapter cards. Like NDIS, ODI is protocol-independent and is supported by many NIC vendors and OSs.

**Packet** An individual bundle of data that is transmitted across the network. Each packet includes information about its size, origin, and destination, as well as error detection and correction bits, in addition to the data being sent.

**RJ-45 port** The standard 8-pin connector found in hubs and NICs. Twisted-pair cable runs between two RJ-45 ports.

**Uplink port** A jack on a hub that connects slower devices and faster backbones, such as a 10-Mbps Ethernet LAN and a 100-Mbps Fast Ethernet backbone.

adapter, and Linksys offers another kit that comes with ISA adapters.

All of the adapters, except those from NetGear, are regular 10-Mbps Ethernet. NetGear was the only vendor to provide adapters that can run at either 10 or 100 Mbps, though 10 Mbps is the maximum you will get using the 10-Mbps hubs included in the NetGear product. Adapters running at 10 Mbps are more than adequate for most small-office networks, unless most of your work involves very large multimedia or graphics files.

We were surprised to find that the adapters from NDC, NetGear, and 3Com were full-duplex, so you can theoretically get speeds of 20 Mbps, or in the case of the NetGear adapter, 200 Mbps. Only NDC provides a full-duplex hub, so to get those speeds with the other kits you'd have to purchase a full-duplex hub. But operators of most small-office and even large networks should not be concerned with whether the network hardware is full-duplex.

Each of the kits includes a driver disk with all of the software you'll need for almost any NOS on the market, including LANtastic, NetWare, OS/2, Windows 95 and NT, and the different flavors of Unix. However, only HP, Linksys, and 3Com

provide instructions in their written manuals for installing drivers for OSs other than those from Microsoft or Novell. You must search an included disk for those instructions or go to your OS manual.

### CABLE CONNECTIONS

All of the products here include at least two Category 3 or Category 5 unshielded twisted-pair (UTP) cables of various lengths, anywhere from 15-foot cables from Linksys to 50-foot cables from 3Com. Even 15-foot cables should be adequate for connecting a few PCs in a small office. For those who intend to make connections across larger spaces, the Dayna, HP, and 3Com products come with 50-foot cables (see the sidebar "And Then There Are the Cables").

Every hub here includes an uplink port that allows you to daisy-chain up to four hubs together to add more ports as you need them. You can use this port for one of your PCs until you have to daisy-chain another hub, in which case you lose that port to the hub-to-hub connection. Most hubs require you to flip a switch in order to turn the port into an uplink connection.

All of the kits allow you to set up a small-office network without a lot of expense and headaches.

### Dayna Network Starter Kits

If your small-network setup requires more flexibility than the Model T-like product packaging offered by most SOHO networking vendors, you should take a look at Dayna Communications' Network Starter Kit line. The shrink-wrapped kits come with either a five-port hub (in the Home Office Network Starter Kit) or an eight-port hub (in the Small Office Network Starter Kit), with a choice of ISA and PCI adapters for each, so you'll likely find a Dayna Starter Kit that fits your networking needs.

Dayna, traditionally a mainstay Macintosh networking and peripheral company, has accumulated a great deal of experience creating products that are simple to set up and use. Like most of the products here, Dayna's network adapters are Plug and Play-compatible, making them simple to install on operating systems such as Windows 95.

Dayna's cards installed fairly easily, with one small glitch. Like many adapters, the DaynaPorts can be set up using PnP or a manually configurable Jumperless mode. By default, the cards were set to Jumperless, so Windows 95 failed to rec-





The new Intel® Pentium® processor-based HP Vectra V and X Series PCs\* for Business have the capability to remotely and simultaneously power-on PCs in switched-off, standby or sleeping mode and turn them off again.

HP Vectra V and X Series PCs include all the hardware and firmware modifications necessary to implement HP NightDIRECTOR, 1997 EPA ENERGY STAR<sup>SM</sup> award winner.

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**SUMMARY OF FEATURES**

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# Small-Office Network Kits

|                                        | Dayna Home Office Network Starter Kit            | Dayna Small Office Network Starter Kit           | D-Link Network Kit                               | HP Network Kit                             | Linksys Instant Ethernet Series Starter Kit          | NDC Software Network Personal Starter Kit          | NetGear Network Starter Kit                                          | 3Com OfficeConnect Networking Kit              |
|----------------------------------------|--------------------------------------------------|--------------------------------------------------|--------------------------------------------------|--------------------------------------------|------------------------------------------------------|----------------------------------------------------|----------------------------------------------------------------------|------------------------------------------------|
| ■ YES ■ NO                             |                                                  |                                                  |                                                  |                                            |                                                      |                                                    |                                                                      |                                                |
| Products listed in alphabetical order  |                                                  |                                                  |                                                  |                                            |                                                      |                                                    |                                                                      |                                                |
| List price                             | PCI, \$189; ISA, \$159                           | PCI, \$279; ISA, \$207                           | \$119                                            | \$499                                      | \$169                                                | \$105                                              | \$179                                                                | \$339                                          |
| <b>Hub</b>                             |                                                  |                                                  |                                                  |                                            |                                                      |                                                    |                                                                      |                                                |
| Dimensions (HWD, in inches)            | 1.5 x 5.3 x 3.5                                  | 1.5 x 8.3 x 4.5                                  | 1.1 x 7.8 x 4.5                                  | 1.0 x 7.5 x 4.6                            | 1.0 x 4.7 x 3.0                                      | 1.0 x 4.9 x 2.6                                    | 1.1 x 4.0 x 3.7                                                      | 1.4 x 8.7 x 5.3                                |
| Number of RJ-45 ports/network type     | 5/Ethernet                                       | 8/Ethernet                                       | 5/Ethernet                                       | 8/Ethernet                                 | 5/Ethernet                                           | 5/Ethernet                                         | 4/Ethernet                                                           | 8/Ethernet                                     |
| AUI/BNC port                           | ■ ■ (8-port hub only)                            | ■ ■                                              | ■ ■                                              | ■ ■                                        | ■ ■                                                  | ■ ■                                                | ■ ■                                                                  | ■ ■                                            |
| Number of LEDs                         | 13                                               | 19                                               | 2                                                | 28                                         | 13                                                   | 12                                                 | 10                                                                   | 8                                              |
| Uplink port type/speed                 | RJ-45 / 10 Mbps                                  | RJ-45 / 10 Mbps                                  | None                                             | RJ-45 / 10 Mbps                            | RJ-45 / 10 Mbps                                      | RJ-45 / 10 Mbps                                    | RJ-45 / 10 Mbps                                                      | RJ-45 / 10 Mbps                                |
| Wall mounting kit                      | ■                                                | ■                                                | ■                                                | ■                                          | ■                                                    | ■                                                  | ■                                                                    | ■                                              |
| <b>Network Adapter Cards</b>           |                                                  |                                                  |                                                  |                                            |                                                      |                                                    |                                                                      |                                                |
| Number of cards bundled in kit         | 2                                                | 3                                                | 2                                                | 3                                          | 2                                                    | 2                                                  | 2                                                                    | 3                                              |
| Chip set                               | PCI: Digital 21190 v.AE; ISA: RealTek 8019A      | PCI: Digital 21190 v.AE; ISA: RealTek 8019A      | D-Link                                           | Hewlett-Packard                            | Winbond                                              | RealTek 8019A                                      | Digital 21190 v.AE                                                   | 3Com Parallel Tasking Ethernet chip            |
| Bus type                               | Both PCI and ISA                                 | Both PCI and ISA                                 | ISA                                              | PCI                                        | PCI                                                  | ISA                                                | PCI                                                                  | ISA                                            |
| Number of RJ-45 connectors per card    | 1                                                | 1                                                | 1                                                | 1                                          | 1                                                    | 1                                                  | 1                                                                    | 1                                              |
| Other connectors                       | None                                             | ISA cards also have BNC connector                | None                                             | None                                       | BNC                                                  | None                                               | None                                                                 | None                                           |
| Network status/power indicators        | ■ ■                                              | ■ ■                                              | ■ ■                                              | ■ ■                                        | ■ ■                                                  | ■ ■                                                | ■ ■                                                                  | ■ ■                                            |
| <b>Driver OS Support</b>               |                                                  |                                                  |                                                  |                                            |                                                      |                                                    |                                                                      |                                                |
| Latest NDIS version number             | 3                                                | 3                                                | 3                                                | 3                                          | 3                                                    | 3                                                  | 3                                                                    | 3.1                                            |
| Novell's ODI Client DOS                | ■                                                | ■                                                | ■                                                | ■                                          | ■                                                    | ■                                                  | ■                                                                    | ■                                              |
| Novell's ODI Client OS/2               | ■                                                | ■                                                | ■                                                | ■                                          | ■                                                    | ■                                                  | ■                                                                    | ■                                              |
| Windows 3.x/Windows 95                 | ■ ■                                              | ■ ■                                              | ■ ■                                              | ■ ■                                        | ■ ■                                                  | ■ ■                                                | ■ ■                                                                  | ■ ■                                            |
| Windows NT 3.5/Windows NT 4.0          | ■ ■                                              | ■ ■                                              | ■ ■                                              | ■ ■                                        | ■ ■                                                  | ■ ■                                                | ■ ■                                                                  | ■ ■                                            |
| LANManager                             | ■                                                | ■                                                | ■                                                | ■                                          | ■                                                    | ■                                                  | ■                                                                    | ■                                              |
| NetWare 3.x/NetWare 4.x/Intranetware   | ■ ■ ■                                            | ■ ■ ■                                            | ■ ■ ■                                            | ■ ■ ■                                      | ■ ■ ■                                                | ■ ■ ■                                              | ■ ■ ■                                                                | ■ ■ ■                                          |
| LANtastic                              | ■                                                | ■                                                | ■                                                | ■                                          | ■                                                    | ■                                                  | ■                                                                    | ■                                              |
| DOS/Mac OS                             | ■ ■ (PCI only)                                   | ■ ■ (PCI only)                                   | ■ ■                                              | ■ ■                                        | ■ ■                                                  | ■ ■                                                | ■ ■                                                                  | ■ ■                                            |
| OS/2 Warp                              | ■                                                | ■                                                | ■                                                | ■                                          | ■                                                    | ■                                                  | ■                                                                    | ■                                              |
| <b>Cabling</b>                         |                                                  |                                                  |                                                  |                                            |                                                      |                                                    |                                                                      |                                                |
| Type                                   | UTP Category 3                                   | UTP Category 3                                   | UTP Category 5                                   | UTP Category 5                             | UTP Category 5                                       | UTP Category 3                                     | UTP Category 5                                                       | UTP Category 3                                 |
| Length                                 | 50 feet                                          | 50 feet                                          | 20 feet                                          | 50 feet                                    | 15 feet                                              | 25 feet                                            | 25 feet                                                              | 50 feet                                        |
| <b>Support</b>                         |                                                  |                                                  |                                                  |                                            |                                                      |                                                    |                                                                      |                                                |
| Technical-support number               | 800-531-0600                                     | 800-531-0600                                     | 714-598-8150                                     | 800-533-1333                               | 714-261-1288                                         | 800-632-1118, ext. 805                             | 800-211-2069                                                         | 800-638-3266                                   |
| Technical-support hours (eastern time) | 9:00-9:00 M-F                                    | 9:00-9:00 M-F                                    | 9:00-9:00 M-F                                    | 24 hours, 7 days                           | 10:00-6:00, M-F; Noon-4:00 Sat.                      | 10:30-9:30, M-F                                    | 24 hours, 7 days                                                     | 9:00-6:00, M-F                                 |
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| Warranty                               | Lifetime                                         | Lifetime                                         | Lifetime                                         | Lifetime                                   | 5 years                                              | 6 years                                            | Lifetime                                                             | Lifetime                                       |

ognize the card during the bootup sequence (as would any PnP hardware or software). Dayna includes a setup utility to change from Jumperless to PnP mode easily, and directions for using the utility are clearly outlined in the adapter's installation guide.

In each kit you'll find a simple, one-page Easy Setup Guide, which walks you through setting up the adapters and hub. The user's guide is one of the better pieces of documentation we ran across, with pictures and basic, nontechnical

text to simplify the whole install process. But as with most products reviewed here, Dayna stops short of actually guiding you through your networking software setup.

Dayna's kits use the company's DaynaPort Ethernet adapters. The Starter Kits come with either 10-Mbps ISA or 10-Mbps PCI adapters. Both adapters come with RJ-45 connectors. Two LEDs on the back of each card show networking activity and the link status with the hub. Physically, the DaynaPort

ISA adapter works in any 16-bit slot; the DaynaPort PCI adapter fits into a standard 32-bit PCI slot.

The Starter Kits use Dayna's DaynaStar MiniHubs: A five-port version comes with the Home Office kit, and an eight-port version with the Small Office kit. In addition to the RJ-45 connectors, the DaynaStar hubs include an additional port, labeled "Out," for connecting the hub to other DaynaStar hubs or hubs from other companies. As with products from other vendors, when you use this



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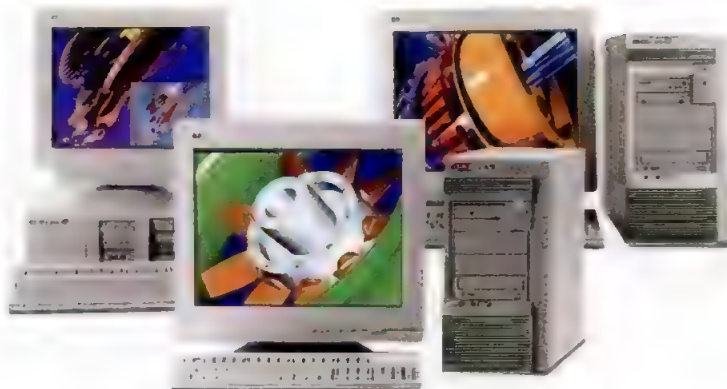
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\*Optional accessory available at additional price. <sup>†</sup>Projected U.S. street price. Microsoft and Windows CE are U.S. registered trademarks of Microsoft Corporation. ©1997 Hewlett-Packard Company PPG450



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The Dayna Network Starter Kit line gives you a choice of ISA or PCI adapters and five-port or eight-port hubs.

port, you automatically disable one of your regular ports, reducing the number of PCs that you can connect to the hub. Like the network adapter, the eight-port DaynaStar also includes a thin coaxial BNC connector for connecting BNC PC adapters to the hub or interconnecting the hub to other hubs.

Both DaynaStar hubs feature a stylish, low-profile design; the five-port hub is identical in size and shape to the hub from Linksys. One downside to the sleek, sloping design is that the hub is harder to stack than competitive products with flat, boxier designs.

Installing the hub was a simple matter. A rich array of link, transmit, and receive lights make it easy to monitor hub activity. The hub also includes a power and collision LED. An activity light flashes more frequently as traffic increases on the network, which is a good basic monitoring tool.

The Dayna Home Office Network Starter Kit also comes with two 50-foot unshielded cables; the Small Office Network Starter Kit comes with three 50-foot cables, certainly ample for most networking situations.

Dayna's documentation was decent. The Setup Guide gave us step-by-step instructions for setting up the adapters and

hubs. As with most products we looked at for this roundup, Dayna dumped the software installation back into our laps, giving no information on setting up even some of the simpler operating systems such as Windows 95.

Dayna provides toll-free technical support from 9:00 to 9:00 eastern time on weekdays. This is somewhat helpful for network installers attempting to assemble their networks after business hours, but there are no technical-support hours on weekends. Also, Dayna didn't publish the toll-free number in its documentation; there's just a mention of the toll number. The company offers a variety of upgrade options, including a hub trade-in. Dayna offers 16-port hubs from its higher-end NetCenter product line, as well as 8-port 10/100-Mbps NetCenter Ethernet switches. A new low-end ISDN and dial-up combination Internet router and remote access box, called the Internet Station, should be available by the time you read this.

The Dayna Network Starter Kits are a good first attempt at a SOHO product.—  
*Tony Pompili*

**Home Office Network Starter Kit.** List price: With ISA adapters, \$159; with PCI adapters, \$189. **Small Office Network Starter Kit.** List price: With ISA adapters, \$209; with PCI adapters, \$279. Dayna Communications, Salt Lake City; 800-531-0600, 801-269-7200; [www.dayna.com](http://www.dayna.com). Circle 491 on reader service card.

## D-Link Network Kit

If you're looking for a network as portable as a notebook computer, D-Link Systems' D-Link Network Kit, with its compact five-port hub, is a shoo-in.

Simple, compact, and inexpensive, the D-Link kit is a good fit for networks on the go or networks that need to fit into tight spots. D-Link's Hubby hub is so efficient that it can actually get its power from a keyboard cable. This lets you install D-Link's kit even in the most cramped and power-scarce locations. Unfortunately, the Network Kit comes only with ISA adapters, and its documentation is not as geared to the novice as most of the other kits we tested are. D-Link's technical support is available on weekdays from 9:00 to 9:00 eastern time. If you're uncomfortable with hardware and networking or you want to use PCI adapters, look elsewhere.

The Network Kit is D-Link's first pass at a small-office networking package, and it has a few hits and misses. The kit includes two DE-220P ISA 10-Mbps Ethernet adapters. This differs from the Dayna,



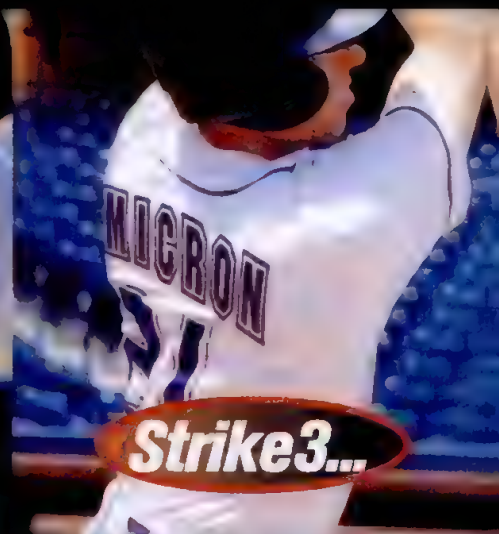
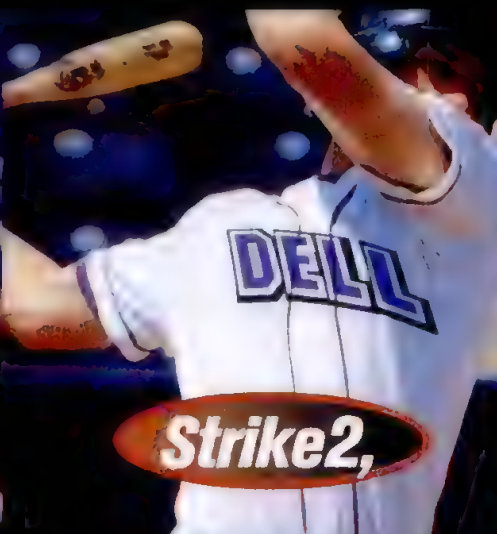
The D-Link Network Kit is easy to install, but the documentation could use some improvement.

Hewlett-Packard, and 3Com network kits, which come with three adapters each. The under-\$100 street price will make the Network Kit appealing to the price-conscious.

Probably the most innovative part of



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## Hub + Router Does It All

By Frank J. Derfler, Jr.

In an office with a dozen or so PCs, it's impractical to give each person an individual ISP account or connection to the corporate LAN. Sharing one fast connection among all users across a LAN makes sense, but it requires setting up a separate router with a leased-line connection, which is dauntingly expensive. We found four products that hide the router functions inside a 10Base-T wiring hub and go a long way toward making it easy to share a single economical modem or ISDN connection and a single ISP account among a number of LAN dwellers.

The Linksys Internet Workgroup Hub (\$349 list), from Linksys (800-546-5797; 714-261-1288; [www.linksys.com](http://www.linksys.com)), relies on an external ISDN or analog modem, which you supply. The hub has four 10Base-T ports, but as with all of these products, you can cascade other standard hubs for more network connections. In the Linksys system, you assign to each PC an IP address taken from a list. A Windows-compatible dialer in the PCs initiates the connection if it isn't already active. This product is fine for a small LAN with few changes in the client configuration anticipated.

The three ISDN router/hub products we looked at—the Cisco 776 ISDN Access Router, Farallon Communications' 635 Netopia Internet Router, and Ramp Networks' WebRamp—each can operate as a dynamic host configuration protocol (DHCP) server. This means that they deliver IP addresses on the fly to all client computers on the LAN, significantly reducing the client setup and maintenance workload. They also can accept a single IP address for the router's wide-area connection, typically provided by an ISP, and make the LAN-side clients invisible to potential hackers.

### **CISCO 776 ISDN ACCESS ROUTER**

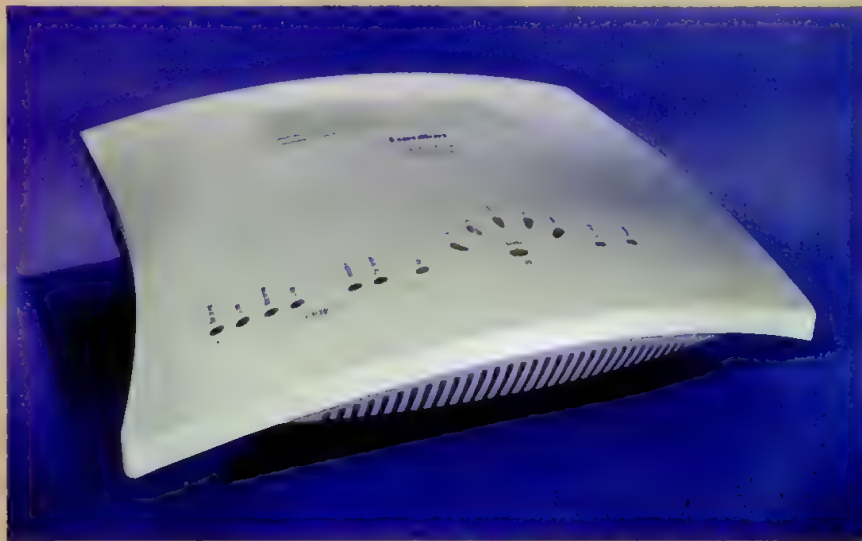
The Cisco 776 ISDN Access Router (\$949 list), from Cisco Systems (800-

553-6387, 408-526-4000; [www.cisco.com](http://www.cisco.com)), is a joy to set up and manage, thanks to the vendor's new ClickStart setup software. ClickStart provides Web pages for setup, so you can use a browser running on any computer to control the system. Cisco also offers graphical Windows-based setup and monitoring software called Fast Step. The 776 Router combines four 10Base-T ports with Cisco's router for IP and IPX and an ISDN terminal adapter. We like the two connections for regular fax, modem, or voice telephone devices. Like all the products in the Cisco 700 family, the 776

776's polish in its administration, or the sophistication of the vendor's DHCP server, but it will accept up to 253 users without any additional cost. This router includes filtering options to keep unwanted IP addresses from going in or out of the LAN. The price makes this product appealing for small networks, but it also has the features needed for LANs with more than a hundred nodes.

### **FARALLON'S 635 NETOPIA INTERNET ROUTER**

A good choice in any scenario, the 635 Netopia Internet Router (\$1,095



Farallon's 635 Netopia Internet Router comes with a PC card slot for modems or ISDN adapters, plus HTML management software.

Router provides sophisticated authentication protocols to screen incoming callers. If you want to go beyond four clients, the next available option is \$150 for a total of 1,500 clients. The Cisco 776 ISDN Access Router is a feature-rich product with new software.

### **RAMP NETWORKS' WEBRAMP**

The WebRamp (\$749 list), from Ramp Networks (408-988-5353; [www.ramp-net.com](http://www.ramp-net.com)), is an eight-port hub and ISDN router in a high-value combination. WebRamp doesn't have the Cisco

list), from Farallon Communications (510-814-5100; [www.farallon.com](http://www.farallon.com)), has only two 10Base-T ports. But it also has a PC Card slot for modems and other connection options. The 635 Netopia Router has all of the important router software features, including authentication of callers and filtering, and it comes with HTML management software. In its basic configuration, the 635 Netopia Router supports 12 users. An upgrade to 29 users is available for \$129 (list), and an upgrade to unlimited user support is \$249 (list).



D-Link's kit is the five-port Hubby Ethernet hub. But as with many of the products reviewed here, the Network Kit's weakest point is its lack of thorough documentation. There's little explanation of what the LEDs mean, and the manual doesn't explain how to connect multiple Hubbys together.

The Network Kit comes with two 20-foot cables, enough for most home office installations. On the network adapter side, we found that installing a DE-220P was pretty straightforward. As with most adapters reviewed here, the DE-220P supports Plug and Play (PnP), so there are no jumpers or DIP switches to set. Windows 95 had no trouble detecting the DE-220P adapter and installing its driver.

For other operating systems, such as DOS and Windows for Workgroups, D-Link includes DOS-based installation and diagnostics software. It also includes device drivers for operating systems including LAN Manager, NetWare 3.x and 4.x, Unix, Vines, and Windows NT. Installation for these operating systems was unfortunately far less automatic, and D-Link provides little installation instruction.

Physically, the half-height card fits into an 8- or 16-bit ISA slot; the driver automatically selects the fastest operation mode. D-Link includes the standard two LEDs on the card to indicate a combination of power, transmit, receive, collision, and jabber—the constant stream of nonsense an adapter emits when it goes bad. The company will offer a kit with a 10Base-T and thin coaxial BNC combo card (\$119 list). For those wanting the speed of a PCI adapter packaged in a convenient kit form, D-Link expects to have a PCI network kit available by the time you read this. It will be based on the company's existing DE-530 PCI adapter family.

D-Link's five-port Hubby was also simple to set up. Unlike its competitors, the hub does not include an uplink or downlink port. Instead, you need to use a cross-over cable (see the sidebar "And Then There Are the Cables") in any one of the five ports to cascade Hubbys should you need to grow. If you don't want to connect the Hubby to your keyboard for power, the Network Kit also comes with a regular power supply.

In case you outgrow your Network Kit, D-Link has a variety of higher-capacity devices for you move to. The company's

higher-end D-Link Office line includes 8- and 16-port hubs as well as 10/100-Mbps autonegotiating Fast Ethernet hubs. For those looking to expand their horizons into the Internet, D-Link also expects to ship its new DI-1135 PC adapter router by the time you read this. The DI-1135 will make it possible for users to connect to an Internet service provider across a local network using a single dial-up or ISDN connection.

If you're looking for an ISA-based network port to fit tight spaces and you're comfortable setting up hardware, check out the D-Link Network Kit.—TP

**D-Link Network Kit.** List price: \$119. D-Link Systems, Irvine, CA; 800-326-1688, 714-455-1688; [www.dlink.com](http://www.dlink.com). Circle 492 on reader service card.

## HP Network Kit

Considering Hewlett-Packard's experience with consumer-oriented products such as printers and PCs, one would expect the HP Network Kit to be easy to set up and configure, and HP doesn't disappoint. The Network Kit (\$499 list) takes advantage of the company's PC, printer, and network peripheral experience in its 10-Mbps PCI and eight-port hub kit, providing thorough hardware installation instructions and comprehensive software installation directions as well. And HP provides technical support 24 hours a day, 7 days week. Unfortunately, if you are short on PCI slots or tight on

cash, HP's kit may not be the best choice.

The HP Network Kit includes three HP DeskDirect PCI LAN adapters and an eight-port AdvanceStack Hub-8E. Probably the most significant component of HP's SOHO networking kit, however, is the user manual of more than 50 pages covering network software installation, a subject forgotten by many other network kit vendors in this roundup. The Network Kit is geared toward Windows 95 networks and includes detailed instructions not only on installing the hardware but also on using Windows 95's built-in networking software to set up shared drives and printers in a peer-to-peer environment. The HP Setup Guide also provides fairly detailed instructions on installing the HP Network Kit in NetWare and Windows NT environments. Of course, HP is also charging you for this knowledge. The HP kit is double the price of most other PCI-based products, and triple the price of ISA-based products.

Installing the HP DeskDirect adapters—which work with any PCI 2 bus—was a snap. Like most of the products in this roundup, HP supplies a network driver disk, which Windows 95 asked for during installation. The DeskDirect adapter itself is unremarkable. It offers a single RJ-45 connector for unshielded twisted-pair wiring only, while other companies such as Dayna Communications and Linksys supplied adapters with both



At \$499, the HP Network Kit is the most expensive kit in this roundup, but it comes with three NICs, an eight-port hub, and 24-hour, 7-day technical support.



RJ-45 and BNC connectors for thin coaxial cabling (see the sidebar "And Then There Are the Cables"). And as with other products reviewed here, the adapters include a simple pair of LEDs on the back to give you link and network-activity status, and the kit comes with three 50-foot Category 5 cables.

The AdvancedStack Hub-8E includes eight workstation ports, with an extra BNC port for connecting or cascading the AdvanceStack with other HP or third-party hubs. The hub features active and link lights for each port, as well as a partition indicator in case you're using the BNC connector. The HP hub has a set of five tracer-type LEDs, similar to volume indicators on stereo amplifiers, to indicate network traffic as well as power and collision LEDs. Slots on the bottom let you mount the HP hub under a desk or vertically on a wall. The hub's boxy shape, however, lends itself to horizontal installation and makes stacking other HP AdvanceStack hubs directly on top a simple matter.

Of course, when it comes to growth, HP offers a full line of upgrade hubs and switches, as well as its popular JetDirect print servers, which can speed up printing in larger networking environments.

As usual, HP did its homework, but at a price. HP leaves you out in the cold if you're looking for a kit with ISA adapters. Also, the relatively high price may be a little daunting, especially for more experienced network installers who don't need all of the hand-holding. Nonetheless, if you're looking for a PCI kit and price is not an issue, HP has by far one of the best products in the bunch.—*TP*

**HP Network Kit.** List price: \$499. Hewlett-Packard Co., Palo Alto, CA; 800-533-1333; [www.hp.com](http://www.hp.com). Circle 493 on reader service card.

## Linksys Instant Ethernet Series Network Starter Kit



The Linksys Instant Ethernet Series Network Starter Kit has everything you need to connect two PCs together and, at a list price of \$169 and street price of \$130, is one of the lower-priced packages on the market. The kit includes two 32-bit PCI Ethernet adapters, a five-port

10Base-T hub with an uplink port, and two 15-foot Category 5 UTP cables. Linksys also offers a whole line of other products to meet your needs as your network grows. To go with the small footprint of the hub and the low price of the kit, the written documentation is a conveniently sized pamphlet; though it contains few graphics, it has easy-to-understand step-by-step instructions for configuring all Windows-based operating systems as well as NetWare. Other operating systems are covered by online documentation. Technical support is available from 10:00 to 8:00 eastern time on weekdays, noon to 4:00 on Saturdays.

Despite its lack of diagrams, the documentation walks you through all of the necessary steps for hardware installation, and

testing. The technical-support operator told us that the technicians were extremely busy and it could be a few hours before a technician called back; happily, we received a response in less than an hour.

Each 32-bit PCI adapter card includes an RJ-45 connector and a single LED. The LED lights up when you connect to an active hub and blinks when it sees traffic on the network. The adapter also has a slot for a boot PROM in case you need to use it in a diskless workstation. Linksys also offers a kit with 16-bit ISA Ethernet adapters—the Network in a Box—for \$99 list, \$70 street, and sells other network components, including print servers, Fast Ethernet hubs, Ethernet switches, POTS-based routers, and PC Card adapters.

The Linksys five-port hub is identical



It contains few diagrams, but Linksys's documentation for the Instant Ethernet Series Network Starter Kit includes configuration instructions for several operating systems.

the PCI Ethernet adapters are Plug and Play—in our tests, Windows 95 was able to detect them at startup. The package also includes NDIS, ODI, and Packet drivers for use with all of the major network operating systems. As with NDC's SOHware Kit, the setup disk also offers a diagnostic utility that will test your network adapters and allow you to change the settings.

While we didn't really have any problems installing the package, we called technical support anyway as part of our

to Dayna's five-port hub, in the same lightweight category as the hubs from NDC and NetGear. The hub provides five 10Base-T ports; you can use one of those ports as an uplink connection for cascading multiple hubs. Unlike the NDC hub, you don't have to flip a switch to use the uplink port, nor do you have to use any special crossover cables. The Linksys hub automatically detects whether the uplink port is connected to another hub and performs the crossover connection for you.

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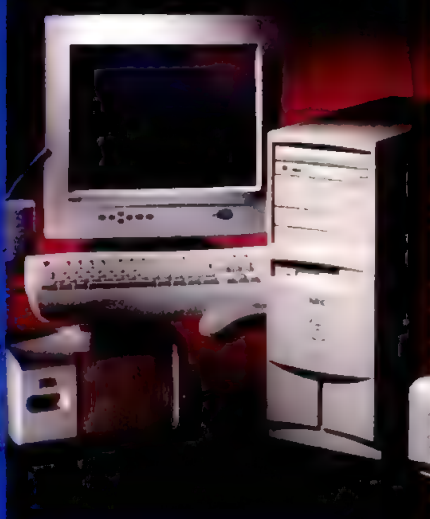
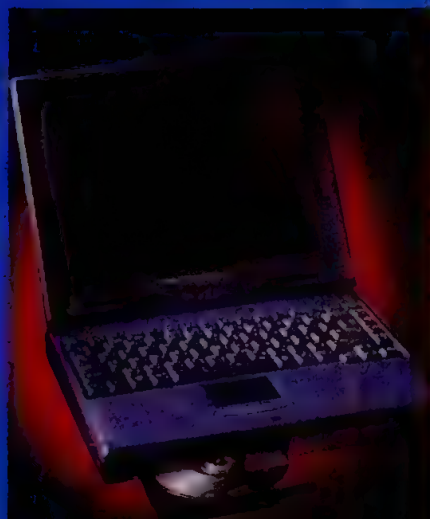
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The hub also has a reset button on the front panel. The hub provides two LEDs for each port, one for links and transmits and another for activity and receives. There are also separate LEDs for collisions, status, and power for the entire unit. Weighing in at 6 ounces and housed in a chassis about the size of your hand, the Linksys five-port hub will easily fit on the most cluttered desk. The hub also has screw holes on the bottom of the unit, which you can use to mount it on a wall or under a table.

The 15-foot cables are probably long enough for most small offices, but other packages, including the ones from NetGear and 3Com, provide 25- and even 50-foot cables. If you are going to spread your PCs across a large area, you will need to replace the Network Starter Kit's cables. Unlike most of the other kits, the Linksys cables also lacked boots on the connectors. The boots prevent the clips from breaking, a common occurrence in most networks.—*Steve Rigney*

**Instant Ethernet Series Network Starter Kit.** List price: \$169. Linksys Inc., Irvine, CA; 800-546-5797, 714-261-1288; fax, 714-261-8868; [www.linksys.com](http://www.linksys.com). Circle 494 on reader service card.

## NDC SOHware Network Personal Starter Kit

The packaging for the SOHware Network Personal Starter Kit is a toaster-size box with a handle, your first indicator that this compact kit is a good choice for the home or small office with tight quarters and a tight budget. The bundled five-port 10Base-T hub, measuring 1.0 by 4.9 by 2.6 inches (HWD), is among the smallest on the market. The list price of \$105 and the street price of \$100—the lowest price in this roundup—also aims this package at the home- and small-office market with networks of between 2 and 14 PCs. Unfortunately, free technical support from NDC is available only from 7:30 to 6:30 Pacific time on weekdays, making weekend installations of a home network less than convenient. And installation is painless only if you're running Windows 95.

The first thing we noticed about the SOHware Kit was the size of the five-port 10Base-T hub: It looks more like a pocket calculator than a connectivity device. Even more impressive is that it

works with full-duplex 20-Mbps connections. You can use the fifth port on the SOHware hub as an uplink to connect to another hub, but you have to move a switch to get the uplink function and you lose that port for connecting to a PC. The



The five-port hub that comes with the NDC SOHware Network Personal Starter kit was the most compact hub we saw.

hub has a link/receive LED and a partition LED above each port. The link/receive light blinks green if the port is receiving traffic, and the partition light turns red if there is a problem with the port. There also is a power LED and a collision LED for the entire unit. The hub cannot be mounted on a wall or desk, but it is small enough to place almost anywhere, including on top of your monitor. The two 25-foot 10Base-T cables should be long enough for most small-network setups.

The two network adapters are 16-bit ISA cards, and they are NE2000-compatible, so they can work with any OS as well as with Windows 95's Plug and Play. In our tests, we installed them in a PC running Windows 95. Windows 95 recognized the adapters as NE2000-compatible and requested the software disk bundled with the kit.

While it is extremely easy to install the adapters in a PC running Windows 95, it takes some extra effort for other operating systems. The software disk provides an easy-to-follow graphical utility for installing the correct drivers on a PC running NetWare or Windows for Workgroups. If you are using another network, such as LANtastic or OS/2 Warp, you will have to search the disk for the text file that contains those installation instruc-

tions. To make things more confusing, the LANtastic directory mentions only versions 4.x and 5.x—the latest version of LANtastic is 7.0. While these older drivers will work, the wrong version number could confuse a novice user.

In addition to the network drivers, the software disk includes a fairly powerful diagnostics utility. You can use this DOS-based utility to change the settings on your adapters, including the interrupt, I/O address, and duplex modes. The utility will then test your settings to make sure that there are no conflicts. However, if you change the card from its original settings, you may have to change the settings of your network software. Unfortunately, the manual doesn't do a good job of explaining this.

The documentation doesn't cover a lot of the steps necessary to install drivers for networks other than NetWare and Windows, and it doesn't explain what to do if you change your card settings, but it is somewhat useful. It includes basic diagrams, definitions of key network terms, and all of the information you'll need to use the kit with a Windows 95 network.

We like the SOHware kit, but we'd like to see some improvement in the documentation and more generous technical support hours.—*SR*

**SOHware Network Personal Starter Kit.** List price: \$105. NDC Communications Inc., Sunnyvale, CA; 408-730-0888; fax, 408-730-0889; [www.ndclan.com](http://www.ndclan.com). Circle 495 on reader service card.

## NetGear Network Starter Kit

At first glance, the NetGear Network Starter Kit seems a little lopsided, with two 10/100-Mbps PCI adapters but only a 10-Mbps four-port hub. However, with a list price of \$179 and a street price of \$140, the kit is fairly inexpensive, and the 10/100-Mbps adapters are an excellent choice if you are planning future expansion of your network. The kit's documentation is well designed, and the toll-free 24-hour technical support and lifetime warranty should help even the most novice user relax.

While not quite as thorough as



3Com's, NetGear's documentation will definitely make your life easier. The kit includes a getting-started manual, which provides basic networking definitions, cabling diagrams, and an explanation of each of the components in the kit. The FA310TX network adapters also come with their own documentation, as does the EN104TP four-port hub. If you do encounter any problems, you can call the toll-free technical-support number any time of the day or week.

The FA310TX network adapters run at both 10- and 100-Mbps speeds and provide a full-duplex option. Using full duplex, you can reach a total throughput of 200 Mbps, which is more bandwidth than a small office will ever use—it's faster than

the bundled 10-Mbps hub can support. The adapters also include five easy-to-read LEDs, which provide information on the link, traffic, collisions, duplex, and 100-Mbps connections. These PCI cards work with the Plug-and-Play standard, but there are a few extra steps you have to take.

When you first install the FA310TX in a Windows 95-based PC, the OS recognizes the chip set on the card as a DEC-chip 21140 PCI adapter and installs it as such. You should remove that driver and use the disk provided with the kit to configure the card as a NetGear FA310TX successfully. The steps are covered in the documentation, but we found the extra work required to be a little annoying. The kit includes a diagnostic disk that allows

you to test your adapters, but it doesn't let you change interrupt or I/O settings on the card. This is usually not a problem if you are using an OS such as Windows 95 that works with Plug and Play. However, if you want to use the cards with other OSs, you may find that you have a conflict and need to change the settings via the setup software. The driver disk does allow you to choose among several OSs, including LANtastic, NetWare, and Windows 3.x, and it automatically installs the drivers for you. The adapter includes ODI, NDIS, and Packet drivers, so you should have no problem using them with whatever network you are running. Note that NetGear doesn't provide an ISA adapter in its family of products.

## User Testing: Getting That Net to Work

**T**he products in this roundup promise to make installing a home-office or small-office network easy. We challenged these claims by bringing a group of network novices into PC Labs and asking them to set up networks using these products. Each participant knew something of computers and hardware installation but little about networking.

Our tests yielded a mix of successes and failures. On the whole, our users were able to set up and configure the hardware using the included documentation. But few of the products delivered when it came to configuring Windows 95 or some other OS.

### THE USERS

Each person in our test group had a few years of PC experience and had at least one system at home. Though none had ever installed a network, all claimed to know a little about networking and said they were familiar with terms such as LAN and NIC. Most felt comfortable working inside a PC. Some knew a little about Windows 95's networking features.

Each participant was issued two Windows 95 PCs, a printer, and one network kit product to install. We asked each to connect the PCs to the hub, following the product's instructions, and set up a peer-to-peer network to share hard disks and the printer. We also asked each user to copy files from one PC to another and print from each PC. If necessary, we allowed users to call the vendor's technical support number. We asked the participants to stop after an hour and a half, whether or not they had finished.

### THE RESULTS

All participants finished with relative ease within our time limit. They all said they found the parts of the kit easy to identify and connections well marked. Most said they knew how to add additional PCs to the network.

HP, Linksys, NetGear, and 3Com include instructions for configuring Windows 95 resource sharing. The rest don't. Many of the users who set up kits without these instructions said they would have liked to have had them. Most vendors merely refer you

to your Windows 95 documentation, assuming that you'll have Windows 95 manuals handy. This can cause some problems: after NDC's documentation guides you through installing the SOHware Network Personal Starter Kit and identifying the PCs to the network, it refers you to directions in the Windows 95 manual for resource sharing. Following those instructions, our tester installed the adapter's driver a second time prior to restarting the system. The result: The system was rendered useless.

We didn't see any tester try to use Windows 95 Help. Few placed technical support calls during our test session. One tester who did call tech support managed to get some help setting up file sharing but was turned away when it came to assistance with printer configuration under Windows 95.

Sharing resources and using the Network Neighborhood under Windows 95 are mysteries for those who haven't used them before. A few instructions and screenshots would go a long way toward relieving user frustration. Vendors should include at least instructions for Windows 95 and both Web- and fax-accessible instructions for other operating systems.

—Jeffrey G. Witt

*One tester who called  
tech support got help  
setting up file sharing  
but was turned away  
when it came to assistance  
with printer  
configuration.*





The NetGear Network Starter Kit was the only kit with 10/100-Mbps NICs, but its hub also had one fewer port (four in all) than most of the other kits.

The EN104TP hub is the only four-port hub in this roundup—other hubs come with five or eight ports. It includes a mounting kit for attaching the hub to a wall or a table, but the hub is so small it could easily fit almost anywhere. You can use the fourth port on the unit as an uplink port to connect the EN104TP to another hub. NetGear provides a button that switches the port between uplink and normal modes, so that you use the fourth port for uplink without buying a special crossover cable. Each port on the hub has one LED that represents a link and another that blinks when the port is receiving traffic. There is also a single collision light and a power light on the unit. The kit includes two 25-foot 10Base-T cables that will work with both 10- and 100-Mbps connections.

The NetGear family doesn't currently include fax, print, or CD-ROM servers (though the company plans to add these components in the near future), but it

## And Then There Are the Cables

By Padraic Boyle

**C**ables are the veins of a computer network. Data is pumped through these wires, delivering information from point to point. Two common types of cabling used today are unshielded twisted pair (UTP) and coaxial.

Available in categories 3, 4, or 5, UTP is capable of handling traffic from 10 Mbps to 100 Mbps. Category 3 is used for telephone systems, and categories 4 and 5 are used for telephone and data networks. For home- or small-office networks running 10 Mbps Ethernet, Category 3 cabling should be satisfactory. If you need the performance advantages of 100-Mbps Ethernet, or if you expect your network to grow significantly in the future, go with Category 5 cabling. It's not significantly more expensive than Category 3 and comes with four of the network kits we reviewed in this feature (see the "Summary of Features" table).

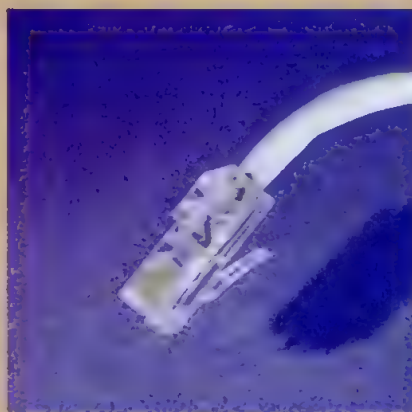
To connect your network over UTP, a hub is needed. Acting like the network's heart, the hub is located in the center of a hub-and-spoke configuration. From there, individual cables

are connected from the hub to each computer on the network.

An alternative to UTP is one of the oldest cable types in the industry: coaxial cable. Coax, as it is better known, still provides one of the easiest and cheapest ways to network computers. Unlike UTP, coax doesn't need a hub. Instead, each computer is connected to another in a daisy-chain fashion to create a bus. T-connectors on each computer are used to link a section of coax from one

computer to the next. The downside is that unlike with UTP, if any cable or adapter fails, the whole network goes down.

The dominant cable installed in many companies today is UTP, yet coaxial cabling still has its merits in small peer networks. Both can be purchased from your local computer store or via the Internet from such vendors as Black Box ([www.blackbox.com](http://www.blackbox.com)) or Monster Cable ([www.monstercable.com](http://www.monstercable.com)).



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Coaxial cable with a BNC connector.



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does offer a good path for growth. The NetGear line includes Ethernet switches, 10/100-Mbps hubs, and higher-density 10-Mbps hubs. All of the NetGear products come with lifetime warranties, except for the external power supply for the hub.

The NetGear Network Starter Kit makes a good solution for small-network operators who anticipate an upgrade to Fast Ethernet in the future.—SR

**NetGear Network Starter Kit.** List price: \$179. NetGear, a division of Bay Networks Inc., Fremont, CA; 888-638-4327, 510-490-4744; netgear.baynetworks.com

### 3Com OfficeConnect Networking Kit



Don't let the relatively expensive list price of \$339 (\$300 street) for the 3Com OfficeConnect Networking Kit fool you. While almost all of the other kits in this roundup offer two network adapters, a four- or five-port Ethernet hub, and a pair of network cables, OfficeConnect bundles three 10-Mbps ISA network adapters, an eight-port hub, and three 50-foot 10Base-T cables, making it perfect for larger small offices or offices with growth in mind. If you're looking for other ways to share, the OfficeConnect family includes more components—including fax, CD-ROM, and print servers—than any other vendor in this roundup. Combine that with superb documentation, a lifetime warranty, and ease of installation, and you should be able to look past the expensive price tag.

The OfficeConnect manual is obviously designed for the novice network user. It includes detailed diagrams of every network component as well as definitions of the components in the kit and other network hardware you may add later. There are even worksheets you can fill out to plan your installation and keep track of the different names you assign to each device. If you do need assistance, 3Com offers toll-free technical support from 9:00 to 8:00 eastern time, but only on weekdays. The support policy is confusing: The documentation claims that free support is only available for 30 days, but a 3Com representative told us that the support is always free; 3Com just uses the 30-days disclaimer to convince users to call in early.

Unlike the SOHware Kit, the OfficeConnect Networking Kit is not designed especially for Windows 95 users. The bundled EtherLink III ISA network adapters are compliant with Windows 95's Plug and Play, but the included driver disk makes it easy to install the adapters with any network operating system, including LANtastic, NetWare, OS/2, and even Vines. The disk also provides a diagnostic utility that allows you to change the settings on the card and test it with your PC. If you need a PCI network adapter, 3Com offers its 10-Mbps XL adapters for \$139 (list). 3Com also claims it will offer a PCI kit in the near future.

In addition to providing excellent driver support, the EtherLink III adapters offer a technology called Parallel Tasking to enhance your network's performance. In a nutshell, Parallel Tasking uses caching and simultaneous communications to increase the speed of the network. For example, when the adapter is receiving information it is simultaneously sending data. Parallel Tasking offers enhanced performance only if all of your PCs are using the 3Com adapters.

The ISA adapters can work simultaneously to provide full-duplex speeds of 20 Mbps, but as with the package from NetGear, the bundled hub doesn't work with full duplex. If you need to increase the speed of your network, you can choose

from several 100-Mbps and Ethernet switches in the OfficeConnect family—but, as with the other products except NetGear's, if you go with a 100-Mbps hub you'll have to purchase new 100-Mbps adapters as well. The bundled hub does include a BNC port on the back for connecting to a coaxial cable. Each port features an LED for traffic and connection information. The OfficeConnect is also one of the only products in this roundup that provides LEDs for network bandwidth usage. You can take a quick glance at the hub to determine the amount of traffic traveling across your network cable.

The OfficeConnect hub is one of the biggest in this roundup (1.4 by 8.7 by 5.3 inches), but it does offer more available ports. Like all of the products in this roundup, the OfficeConnect hub includes clips you can use to stack the components together. This means that you can easily stack your hub to an OfficeConnect print or CD-ROM server or ISDN dial-up router. If you need a networking kit for a growing small office, look no further than the 3Com OfficeConnect Networking Kit.—SR

**3Com OfficeConnect Networking Kit.** List price: \$339. 3Com Corp., Santa Clara, CA; 408-764-5000; fax, 408-764-5001; www.3com.com. Circle 497 on reader service card. PC



3Com's OfficeConnect Networking Kit comes with the best documentation we saw in this roundup.



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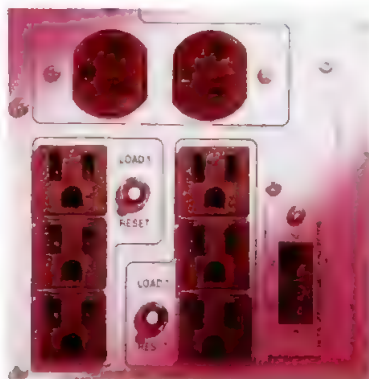
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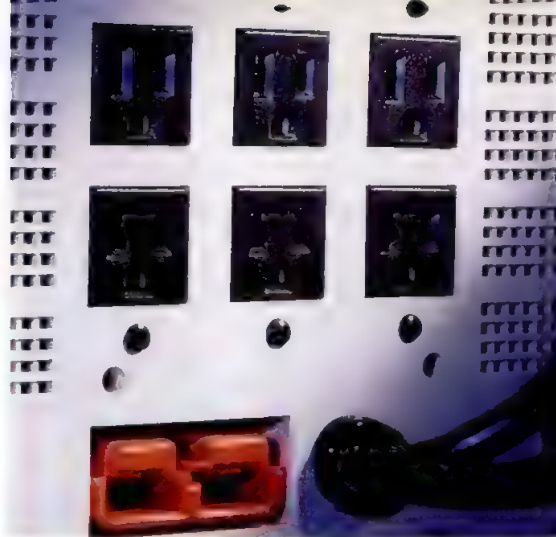
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## Hardware



Having separate circuits lets you shut down less critical components if power runs low.



Be sure your UPS provides enough protected outlets for all your equipment—CPU, monitor, modem, and so on.

## UNINTERRUPTIBLE POWER SUPPLIES

# THE POWER BROKERS

An intuitive control panel will let you check UPS and utility power status with just a glance.



These ten server-level UPSs will keep clean power flowing to your vital equipment. You can bet your business on it.

Look for user-replaceable, hot-swappable batteries to cut maintenance costs. The option to add more batteries is a plus.

*By Winn L. Rosch*

**P**ower protection is like life insurance: You don't want to think about why you need it, but you will need it sooner or later. Life insurance for your computer equipment can be as simple as a surge suppressor to intercept deadly electrical spikes, or as complex as an uninterruptible power supply (UPS) to keep the power flowing even through a blackout.

### IN THIS REVIEW

|                                   |     |                                 |     |
|-----------------------------------|-----|---------------------------------|-----|
| APC Smart-UPS 2200 .....          | 204 | Para Systems Minuteman          |     |
| Best Power Fortress LI1420U ..... | 205 | XRT 2000 .....                  | 216 |
| Best Power Fortress LI2KH .....   | 205 | Toshiba 1400SE .....            | 217 |
| Deltac PowerRite Pro II .....     | 209 | Tripp Lite Smart 2200 Net ..... | 217 |
| Exide NetUPS SE .....             | 209 | Editors' Choice .....           | 200 |
| Liebert PowerSure                 |     | Performance Tests .....         | 208 |
| Interactive .....                 | 212 | Personal Powerhouses .....      | 212 |
| MGE Pulsar EX20 .....             | 214 | Summary of Features .....       | 216 |

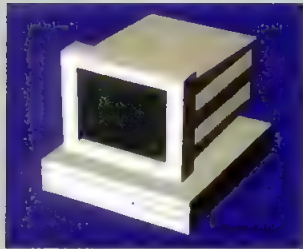
PHOTOGRAPHS BY SCOTT PETERSON





## Determining Your UPS Needs

### Mainstream desktop Pentium PC with a 15- or 17-inch monitor



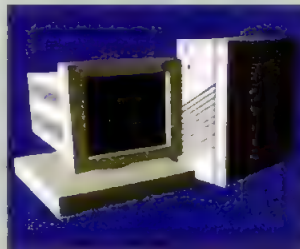
**Recommended rating:** 200–300 VA

**Typical runtime:** 6–12 minutes

**Price range:** \$90–\$300

**Comments:** Look for at least two powered outlets (for your CPU and monitor), plus surge-protected outlets for your printer, Zip drive, speakers, and other peripherals. A surge-protected modem jack is a plus, as is software that can gracefully save files and shut down applications unattended.

### Dual-processor Pentium workstation with two hard disks and a 21-inch monitor



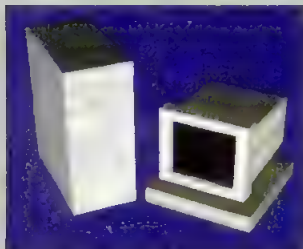
**Recommended rating:** 450–650 VA

**Typical runtime:** 10–15 minutes

**Price range:** \$175–\$450

**Comments:** You'll want three or four powered outlets for your CPU, monitor, and external drives. Look for a UPS that delivers at least 10 minutes of runtime to let you save and close important files. Software that can gracefully save files and shut down applications unattended is a plus.

### One file or application server with several disk drives and a 14- or 15-inch monitor



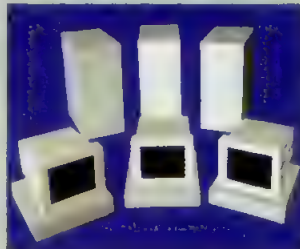
**Recommended rating:** 1,000 VA

**Typical runtime:** 8–15 minutes

**Price range:** \$400–\$750

**Comments:** Look for at least two powered 120V outlets and a surge-protected modem jack. User-replaceable, hot-swappable batteries will lower lifetime maintenance costs. Be sure the unit plugs into a standard 120V wall outlet. Network management software is a plus; shutdown software is a must.

### Two or three servers, each with several disk drives and a 14- or 15-inch monitor



**Recommended rating:** 1,400–2,200 VA (reviewed here)

**Typical runtime:** 8–20 minutes

**Price range:** \$650–\$1,200

**Comments:** Look for at least four powered 120V outlets, plus outlets for equipment that requires 30 amps. The ability to daisy-chain additional batteries is a plus. Intuitive network management software that can send broadcast messages and e-mail and pager alerts to the network administrator is a must.

### Server room or data center



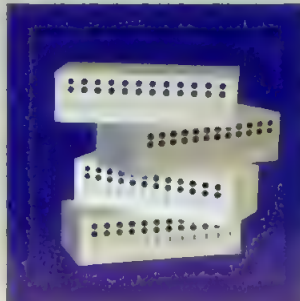
**Recommended rating:** 3000–5000 VA

**Typical runtime:** 10–20 minutes

**Price range:** \$1,500–\$3,000

**Comments:** For large, mission-critical installations, you can opt for one large UPS or several smaller UPSs, depending on your protection philosophy. Having several units means more maintenance and increases your chances of encountering a UPS problem down the road; if a single large unit has a problem, it could bring your entire operation to a halt.

### Network hubs and routers



**Recommended rating:** 200–300 VA

**Typical runtime:** 10–20 minutes

**Price range:** \$100–\$300

**Comments:** Typically, a UPS vendor has a line of equipment designed specifically for network infrastructure components. Look for basic surge and blackout protection. Remote-communications capabilities may be needed for installations, which would then require SNMP-type adapters.

A UPS can be a lot more than a safety net, however. Better UPSs constantly monitor and regulate the quality of the power coming from the wall outlet (called *line conditioning* or *power conditioning*), so your equipment always receives the clean 120-volt power it was designed for. And with the advanced software available with higher-end units, network administrators can check the status of the UPS from a network node or even via the Web and be alerted via e-mail or phone page if there's a problem with the power in the server room.

If utility power doesn't come back be-

fore the UPS battery is depleted, the software can initiate a graceful shutdown of the system, warning each user of the impending failure and even saving user files. There also are environmental monitors that can keep tabs on the temperature of the room or let you know if there's a flood or other catastrophe endangering your equipment.

#### REVIEW CRITERIA

UPSs come in a range of sizes, from \$99 units that can keep a typical desktop PC running for a few minutes to \$5,000 battery-packed monsters that can fuel a corporate

data center for half an hour or more. The largest market segment comprises units in the 1,000- to 3,000-volt-ampere (or 1- to 3-kVA) range, which are robust enough to protect and power two or three network servers and their monitors and modems.

For this story we solicited units from the top vendors based on market-share information from Venture Development Corp., a Natick, Massachusetts-based market research firm. We asked the vendors for product in the 2-kVA ballpark—suitable for protecting a pair of network servers, with plenty of room to grow. Nine ven-



## Uninterruptible Power Supplies

dors—APC, Best Power, Deltec, Exide, Liebert, MGE, Para Systems, Toshiba, and Tripp Lite submitted products. For comparison, we also tested a 1,400-VA-class UPS from Best Power.

Practically speaking, each UPS in this evaluation will loaf along with just two servers attached. When we hooked two HP NetServers and a workstation to each, the devices uniformly indicated a light load, averaging about 25 percent capacity. This class of UPS could be stretched to accommodate an entire small business or workgroup. Such overcapacity translates more or less into longer runtime. That is, a UPS designed to back up four servers for 10 minutes can also back up two servers for 20 minutes (more or less). (For an explanation of why you shouldn't simply buy a bigger UPS to get longer runtime, however, keep reading.)

One conclusion from our testing was inescapable: When the power goes out, all these products kick in, reliably and repeatedly. Differences arise in how well a UPS automatically manages each emergency and how elegantly it handles each "power event," whether it's a brownout, blackout, surge, or spike.

## DIFFERENT APPROACHES TO HARDWARE

The differences in hardware among the nine units we tested begin with the basic architecture of the UPS. The classic UPS (back in the days before the industry muddled the designation "uninterruptible") is the *double-conversion* design (also called *on-line*), which uses batteries as a power buffer to swallow up spikes, surges, and sags full-time. This kind of UPS first converts utility power to low-voltage DC for the battery, then converts that back to the AC needed by your electronic gear. The batteries are always on-line, so power is never interrupted by switching even in the event of a power failure. In this roundup, only the MGE and Toshiba devices rate as true double-conversion UPSs.

A *standby power system* switches between utility and battery power when utility power fails. The standby system cuts costs by using a smaller charger, one incapable of handling the load by itself and only able to charge the batteries slowly—which means a period of a few hours or

overnight when the devices can deliver little or no backup protection after a failure. The standby system also leaves a brief switching interval, on the order of 2 to 10 milliseconds, during which your equipment gets no power at all. Nearly all modern computer equipment can ignore this brief break; the only PCs sensitive to it are more than a decade old.

The most common device, and the design used by seven of the nine units we tested, is the *line-interactive* UPS. By itself, a standby system protects only against blackouts, leaving your equipment vulnerable to other power anomalies. Line-interactive UPSs go one step further by constantly monitoring the integrity of your utility power, *boosting* or *bucking* (reducing) voltage to your PCs whenever line voltage rises too high or falls too low, and switching to battery power if the deviation becomes too great.

The chief advantages of the line-interactive design over the on-line design are lower cost (there's less circuitry to build) and supposedly increased long-term reliability (there's less circuitry to fail). Indeed, Toshiba's on-line unit in this

roundup sells for nearly three times as much (\$2,800 street) as the typical line-interactive unit. On the other hand, the on-line UPS truly isolates your PC from the power grid and may be the only way to maintain stable system operation when utility power is particularly unstable, or when the computer is controlling a device such as a dialysis machine or heart-monitoring station.

Although line-interactive UPSs allow more variation in the voltage supplied to your PC than do on-line units (which are essentially unvarying), all devices in this review kept their outputs between +10 percent and -20 percent of a nominal 120 volts. All devices in this review also achieve a UL 1449 listing for surge protection.

## CELL MATES

The capacity of a UPS can be measured in two ways, as power or energy. *Power* (measured in *volt-amperes*, or VA) determines how much equipment the UPS can safely operate. *Energy* (measured in *watt-hours*) determines runtime, how long the

## LANGUAGE OF POWER

**Boost** The addition of UPS battery power to utility power to increase voltage to an acceptable level (0

**Brownout** A condition in which utility voltage falls 10 percent

**Buck** The bucking of utility voltage to

**Joule** A unit of energy

**Line conditioning (or power conditioning)** The process of conditioning power to ensure

**Line-interactive** A type of UPS that can boost or buck

**Load shedding** The process of shedding load to prevent

**On-line** A type of UPS that always uses battery power

**Standby** A type of UPS that switches to battery power

**Surge** A sudden increase in voltage

**Utility** The power supplied by the power company

**Volt-amperes (VA)** A unit of power

**Watt-hours** A unit of energy

**Whichever of the above is the correct answer, please**

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## Editors' Choice

### • Deltec PowerRite Pro II, Exide NetUPS SE



*All ten of the units we tested handled the three most important functions of a UPS with aplomb: They protected our equipment from brownouts and over-*

voltages, they kept the servers running in a black-out, and they shut down the servers gracefully before battery power ran out.

Any of them would be a good choice; hardware and software details dictate the great choice, which in this roundup is the Deltec PowerRite Pro II or the Exide NetUPS SE (\$1,000 street); these are twin units from two divisions of Exide Electronics Group. Unlike most products in this class, they provide two levels of buck and boost line conditioning and perform load shedding, which lets you shut down less critical equipment (such as monitors) to keep power flowing to your servers.



Three other units also performed admirably and deserve honorable mention. Tripp Lite's Smart 2200 Net (\$1,000 street) is an attractively priced, reliable UPS that delivers two phases of line conditioning, and its included management software, Power Alert Plus, supports a range of network environments. The Minuteman XRT 2000 (\$1,400 street)

also has two-stage line conditioning and also performed well. We also liked the easy-to-understand LED readout on the front panel. The APC Smart-UPS 2200 (\$1,060 street) includes the most versatile software of the group, PowerChute plus, and the unit delivered an impressive 19 minutes of runtime in our simulated blackout.

UPS can operate your equipment from its internal reserves.

All too often people choose a UPS with a higher VA rating to get a longer runtime. The more cost-effective approach, however, is to buy extra runtime in the form of greater battery capacity. Five of the units in this roundup have jacks that let you daisy-chain additional battery packs so you can custom-tailor your energy reserves.

Energy reserves in the standard-configuration units we tested were sufficient to operate a 75 percent load (the maximum recommended) from about 6 minutes (the Liebert PowerSure Interactive) to nearly 20 minutes (the APC Smart-UPS 2200 and the MGE Pulsar EX20). All devices allow you to force an operating-system shutdown well before the batteries are drained. The Tripp Lite Smart 2200 Net enforces an early shutdown sequence to prevent excess battery discharge; all the other systems allow the user to override hardware defaults with software settings.

All UPSs in this roundup use some form of sealed lead-acid battery similar to that found in your car. Such a battery's rated working lifetime is three to six years. As the batteries age, runtime gradually declines, then suddenly and precipitously drops. Better UPS designs monitor battery condition with periodic tests and warn when failure is imminent. Better software lets you program test times and logs the results.

Getting the most life from batteries requires properly handling their charge cycles and maintenance. Some manufacturers strictly adhere to battery makers' recommendations; others use their own protocols to extend battery life (an issue we could not examine without delaying this story for about six years).

The power ratings of the larger UPSs carry an unpleasant surprise: Ordinary duplex wall outlets are rated for 15 amps, but 2-kVA and larger UPSs require a 20- or 30-amp outlet. Several units we tested also require a special receptacle to accommodate a twist-lock plug designed to prevent accidental disconnection. In other words, you may need an electrician to install any but the smallest of these UPSs properly.

At the output end, all of the units provide a number of standard outlets, sometimes augmented by higher-amperage connections. Seven of the units we saw divide their outlets into two or more banks with their own circuit breakers. Several go an additional step and give software control to the power at individual outlets. This allows *load shedding*, switching off unnecessary devices to prolong runtime or save power.

For example, in the event of a power outage you can set the software to cut power to the monitors' outlet banks in order to increase the runtime of the more critical servers. Or you can have the UPS power down the monitors over the weekend to conserve energy, while keeping the associated PCs going. Five of the UPSs we tested allow load shedding with add-in software or hardware; the twin Deltec PowerRite Pro II/Exide NetUPS SE units, our Editors' Choices, include that feature.

#### SOFT SIDE

By itself, a UPS only delays power failures, giving you time to shut down your system before the batteries run out. Software is the other half of the equation. The link between UPS and software makes the shutdown automatic so that your PC or network powers down normally during an interruption and resumes normal operation when utility power returns.

The key here is a port to relay status and control information between your PC and the UPS. Most UPSs use a variation on the RS-232C serial port (it's often different enough to require a proprietary cable). Some UPSs allow other connections, such as the hard-wired AS/400 jack on the Toshiba or a 10Base-T network connec-

**Our Contributors:** WINN L. ROSCH is a contributing editor of *PC Magazine* and the author of *The Winn L. Rosch Hardware Bible* (Sams Publishing, 1994). PADRAIC BOYLE is also a contributing editor, and JAMES KARNEY is a frequent contributor to the magazine. JAMIE M. BSALES was the associate editor in charge of this story, and JEFF MACE was the project leader.

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## HARDWARE

### Uninterruptible Power Supplies

tion. The software bundled with more than half of the devices we tested originates at one company, Chesterfield, Missouri-based Systems Enhancement Corp., and is tailored to each UPS vendor's equipment.

UPS software works by periodically polling the UPS, then posting and/or logging its operating parameters. We found a wide range of polling intervals. Some were so annoyingly long that administration became problematic. For example, the MGE and Toshiba units required more than 30 seconds before the software reflected hardware changes.

The UPS software uses the information gleaned from the UPS to display the condition of its input and output power and battery reserves. All the units in this roundup gave a direct display of remaining runtime except for the Toshiba, which indicated the more exact but less meaningful battery voltage. Each software package can log important events, such as a power surge or outage. With add-ons, six of the units can detect environmental conditions such as temperature and water (standard on the MGE Pulsar).

Through your network messaging system, the software can relay information about power to individual workstations and administrators to warn, for example, of an imminent server shutdown. All the units can also link to telephone paging systems to direct your attention to a power failure even while you're having a candlelit dinner. In general, you can program which events will elicit what actions. Although you'll find a wide range in the number of events individual software packages recognize, all include such essentials as power failure, power returns, battery rundown, and so on.

Most UPS software packages also allow remote administration, so you can dial into your UPS and tell it what to do. Most link to major network management packages (such as HP OpenView) to let you manage your UPS as a device on the network. They also provide links with applications such as Microsoft Office and Lotus Notes, automatically naming and saving open files before shutting down the system.

Like life insurance, a UPS is a long-term investment. The reviews, performance tests, and summary of features that

follow will help you determine which UPS matches your needs.

*APC Corp.*

#### **Smart-UPS 2200**

If you're putting together a wish list of capabilities for your next UPS, a good place to start is the spec sheet for APC Corp.'s Smart-UPS 2200 (\$1,060 street). Although this 2.2-kVA line-interactive unit doesn't



perform load shedding or multiple levels of voltage boosting and bucking, APC's software PowerChute plus offers unparalleled features and versatility.

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## Uninterruptible Power Supplies

The Smart-UPS 2200 design includes three separate breaker-protected banks (two banks of two outlets and one bank of four). There is also a wiring fault indicator, a sensitivity indicator, and a button to adjust the unit's sensitivity to impure (distorted) incoming power.

The included software, PowerChute plus, provides a tremendous range of control under Microsoft Windows 95, Windows NT, and NetWare; versions are also available for various Unix flavors, OS/2, IBM LAN Server, and Mac OS. Optional add-ins automatically name and close unsaved server-resident application files (such as Microsoft Office files) before shutting down the server.

In testing, the Smart-UPS showed a split personality. PowerChute reported hardware functions accurately (though graphics were limited to businesslike bar charts). Unlike other units in this roundup, however, the device performed only a single stage of line conditioning, allowing output to dip as low as 103 volts, while multi-stage units we tested never slipped below 110 volts. On the plus side, the Smart-UPS

2200 yielded an exemplary 19 minutes 15 seconds of runtime on our Blackout test. The Smart-UPS 2200XL (\$1,699 list, \$1,200 street) includes a connector for adding up to ten external batteries (\$389 each) to increase the runtime by a maximum of 3.5 hours with a full load.

Excellent software and solid hardware earn the APC Smart-UPS a spot on our short list.—WLR

**Smart-UPS 2200.** Street price, \$1,060; American Power Conversion Corp., West Kingston, RI; 800-877-4080, 401-789-5735; [www.apcc.com](http://www.apcc.com). Circle 470 on reader service card.

## Best Power

**Fortress LI1420U,  
Fortress LI2KH**

For this we roundup we tested UPSs rated at about 2 kVA, such as the Fortress LI2KH (\$990 street). We also wanted to see how a smaller, less expensive unit would fare, and we chose the 1,420-VA Fortress LI1420U (\$650 street). Both of these line-interactive models are reasonably priced and offer all-inclusive power



protection solutions and comprehensive management software. Both displayed fine power-cleaning and output capabilities.

Unlike some units we tested, these models don't let you connect additional batteries to extend runtime. Instead, Best Power equips each with a user-replaceable, hot-swappable battery. Best's management software CheckUPS II graphically displays input and output voltages and the remaining battery power. The meters were closely synchronized with the actual voltage.

Both units shone on our tests, delivering a clean and fairly constant output at







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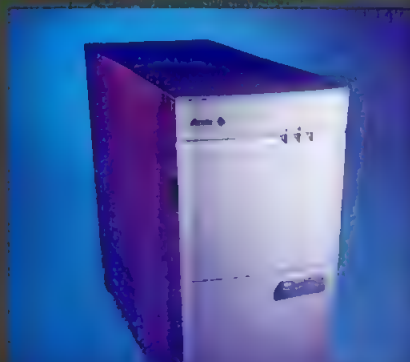
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## PERFORMANCE TESTS

# Uninterruptible Power Supplies



All these UPSs supplied enough battery power to let the management software shut down the load safely. Their line-conditioning prowess varied.

## What the Numbers Mean

Our **Baseline** tests—as well as aspects of the Blackout, Brownout, and Overvoltage tests—were fine indicators of the management software's accuracy and responsiveness. During our Baseline tests, we sent 120 volts of utility power to the UPSs, then compared the actual voltage each sent to the attached devices (measured by a voltmeter) to the voltage reported by the software. Sentry Software (the Para Systems product) reported a constant 120V AC output during

all the tests, regardless of actual output, indicating that the software's reported power output was inaccurate. PowerView Plus (the Toshiba product) averaged a 3-volt discrepancy from the actual voltage. We found the APC, Best Power (Fortress LI2KH), Deltec, and Liebert units' software reporting accurate to within 2 volts or less. Monitoring software used by the online units—SolutionPac (the Pulsar EX20 product) and PowerView Plus—exhibited a 30-second lag in reporting voltage changes. Oddly, Power Alert Plus (the Tripp Lite product) lacks a voltage-reporting feature.

The **Blackout** test determined battery runtime, or how long a unit's batteries supplied power to attached devices during a full power failure. All the UPSs we tested delivered sufficient runtime to allow for a safe shutdown. The longest runtimes were turned in by APC's Smart-UPS 2200 (19:15) and MGE UPS Systems' Pulsar EX20 (19:11). The shortest runtimes came from Liebert Corp.'s PowerSure Interactive (6:20) and Para Systems' Minuteman

XRT 2000 (7:20). The remaining units each provided over 10 minutes of battery power.

We employed our **Brownout** test suite to determine at what point a UPS begins to use battery power to *boost* (or supplement) power flowing to the attached devices. Although some devices boosted low-voltage utility power one time before switching over to full battery power, three UPSs—the Deltec PowerRite Pro II/Exide NetUPS SE, the Para Systems unit, and the Tripp Lite Smart 2200 Net—each performed an additional second phase of power conditioning that allowed for a steadier output voltage. Similarly, on the **Overvoltage** tests, the same three *bucked* (or partially blocked) high-voltage power twice before switching over to battery power. The nature of the online units we tested—the MGE Pulsar EX20 and the Toshiba 1400SE—means they perform continuous power conditioning.

To analyze the quality of the units' output voltage, we also performed a test of their *total harmonic distortion* (THD), a value expressed as a percentage of pure sine-wave voltage output. A THD score of 0 percent is the equivalent of a perfect sine wave; anything larger indicates some level of distortion.

The Tripp Lite Smart 2200 Net delivered the highest THD (and near-square-wave output), ranging from 27 percent when battery power was first engaged to 42 percent at the point of battery rundown. The Deltec PowerRite Pro II/Exide NetUPS SE duo and the APC Smart-UPS 2200 turned in THDs ranging from 17 to 25 percent and 2 to 16 percent respectively, while the others had THDs of under 13

### BASELINE

|                                 | We sent 120 volts to the UPS, and its software reported it was receiving: | ...and the UPS sent to the attached devices: | ...and the software reported the UPS was sending: | We cut the power to the UPS, and it kept our test system running for (minutes:seconds): |
|---------------------------------|---------------------------------------------------------------------------|----------------------------------------------|---------------------------------------------------|-----------------------------------------------------------------------------------------|
| APC Smart-UPS 2200              | 119.6 volts                                                               | 118.9 volts                                  | 119.6 volts                                       | 19:15                                                                                   |
| Best Power Fortress LI1420U     | 121.0 volts                                                               | 118.2 volts                                  | 121.0 volts                                       | 10:53                                                                                   |
| Best Power Fortress LI2KH       | 120.0 volts                                                               | 117.4 volts                                  | 118.0 volts                                       | 15:20                                                                                   |
| Deltec PowerRite, Exide Net UPS | 120.0 volts                                                               | 118.9 volts                                  | 120.0 volts                                       | 11:57                                                                                   |
| Liebert Power Sure Interactive  | 120.0 volts                                                               | 118.4 volts                                  | 117.3 volts                                       | 6:20                                                                                    |
| MGE Pulsar EX20                 | 120.0 volts                                                               | 119.7 volts                                  | N/A                                               | 19:11                                                                                   |
| Para Minuteman XRT 2000         | 117.0 volts                                                               | 116.0 volts                                  | 120.0 volts                                       | 7:20                                                                                    |
| Toshiba 1400SE                  | 120.0 volts                                                               | 120.0 volts                                  | 117.5 volts                                       | 10:53                                                                                   |
| Tripp Lite Smart 2200 Net       | 118.0 volts                                                               | 118.6 volts                                  | N/A                                               | 12:15                                                                                   |

N/A—Not applicable: The product does not have this feature.

### BROWNOUT

|                                 | When we lowered the voltage input to the UPS, it began to boost the incoming voltage with its own battery power at: | ...and the software reported the UPS was receiving: | The UPS boosted the voltage going to the attached devices to: | ...and the software reported the UPS was sending: | The UPS dropped the utility line and relied solely on battery at: | ...and the software reported the UPS was receiving: | The voltage the UPS sent to the attached devices was: | ...and the software reported the UPS was sending: | The UPS returned to utility power when the voltage rose above: |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|---------------------------------------------------------------|---------------------------------------------------|-------------------------------------------------------------------|-----------------------------------------------------|-------------------------------------------------------|---------------------------------------------------|----------------------------------------------------------------|
| APC Smart-UPS 2200              | 103.0 volts                                                                                                         | 102.7 volts                                         | 114.8 volts                                                   | 115.7 volts                                       | 91.3 volts                                                        | 91.6 volts                                          | 121.5 volts                                           | 126.0 volts                                       | 112.4 volts                                                    |
| Best Power Fortress LI1420U     | 104.6 volts                                                                                                         | 104.0 volts                                         | 121.1 volts                                                   | 119.0 volts                                       | 92.1 volts                                                        | 92.0 volts                                          | 118.7 volts                                           | 120.0 volts                                       | 105.6 volts                                                    |
| Best Power Fortress LI2KH       | 105.0 volts                                                                                                         | 104.0 volts                                         | 118.1 volts                                                   | 119.0 volts                                       | 93.5 volts                                                        | 91.0 volts                                          | 120.9 volts                                           | 122.0 volts                                       | 110.9 volts                                                    |
| Deltec PowerRite, Exide Net UPS | 108.0 volts                                                                                                         | 100.0 volts                                         | 122.6 volts                                                   | 120.0 volts                                       | 84.4 volts                                                        | 84.0 volts                                          | 120.3 volts                                           | 122.0 volts                                       | 110.1 volts                                                    |
| Liebert Power Sure Interactive  | 103.3 volts                                                                                                         | 103.8 volts                                         | 115.9 volts                                                   | 115.4 volts                                       | 90.2 volts                                                        | 92.1 volts                                          | 119.0 volts                                           | 117.3 volts                                       | 111.5 volts                                                    |
| MGE Pulsar EX20                 | N/A*                                                                                                                | N/A*                                                | N/A*                                                          | N/A*                                              | 84.9 volts                                                        | 88.0 volts                                          | 119.5 volts                                           | N/A**                                             | 110.5 volts                                                    |
| Para Minuteman XRT 2000         | 111.1 volts                                                                                                         | 108.0 volts                                         | 119.4 volts                                                   | 120.0 volts                                       | 91.8 volts                                                        | 90.0 volts                                          | 120.2 volts                                           | 120.0 volts                                       | 113.3 volts                                                    |
| Toshiba 1400SE                  | N/A*                                                                                                                | N/A*                                                | N/A*                                                          | N/A*                                              | 67.0 volts                                                        | 67.0 volts                                          | 121.8 volts                                           | 117.5 volts                                       | N/A†                                                           |
| Tripp Lite Smart 2200 Net       | 110.0 volts                                                                                                         | 108.0 volts                                         | 118.7 volts                                                   | N/A                                               | 85.3 volts                                                        | 86.0 volts                                          | 107.5 volts                                           | N/A**                                             | 113.3 volts                                                    |

N/A\*—Not applicable: This on-line unit maintains constant output despite input-voltage variations. N/A\*\*—Not applicable: The product does not have this feature. N/A†—Not applicable: The unit's breaker tripped, and the unit could not return to utility power without being reset manually.



## OVERVOLTAGE

|                                 | We sent more than 120 volts to the UPS, and it began to lower (or buck) the power at: | ...and the software reported the UPS was receiving: | The UPS lowered the voltage going to the attached devices to: | ...and the software reported the UPS was sending: | The UPS dropped the utility line and relied solely on battery power at: | The voltage the UPS sent to the attached devices was: |
|---------------------------------|---------------------------------------------------------------------------------------|-----------------------------------------------------|---------------------------------------------------------------|---------------------------------------------------|-------------------------------------------------------------------------|-------------------------------------------------------|
| APC Smart-UPS 2200              | 132.1 volts                                                                           | 131.9 volts                                         | 116.5 volts                                                   | 117.0 volts                                       | 139.0 volts                                                             | 121.2 volts                                           |
| Best Power Fortress LI1420U     | 127.0 volts                                                                           | 127.0 volts                                         | 108.8 volts                                                   | 112.0 volts                                       | 140.5 volts                                                             | 120.6 volts                                           |
| Best Power Fortress LI2KH       | N/A*                                                                                  | N/A*                                                | N/A*                                                          | N/A*                                              | 134.3 volts                                                             | 132.8 volts                                           |
| Deltec PowerRite, Exide Net UPS | 124.8 volts                                                                           | 125.0 volts                                         | 109.2 volts                                                   | 110.0 volts                                       | 141.5 volts                                                             | 123.0 volts                                           |
| Liebert Power Sure Interactive  | 132.5 volts                                                                           | 133.6 volts                                         | 115.4 volts                                                   | 115.5 volts                                       | 140.5 volts                                                             | 122.6 volts                                           |
| MGE Pulsar EX20                 | N/A**                                                                                 | N/A**                                               | N/A**                                                         | N/A**                                             | 139.4 volts                                                             | 118.6 volts                                           |
| Para Minuteman XRT 2000         | 132.7 volts                                                                           | 130.0 volts                                         | 118.9 volts                                                   | 120.0 volts                                       | 144.8 volts                                                             | 120.3 volts                                           |
| Toshiba 1400SE                  | N/A**                                                                                 | N/A**                                               | N/A**                                                         | N/A**                                             | 150.0 volts                                                             | 121.8 volts                                           |
| Tripp Lite Smart 2200 Net       | 130.5 volts                                                                           | 130.0 volts                                         | 111.4 volts                                                   | N/A†                                              | 139.8 volts                                                             | 107.3 volts                                           |

N/A\*—Not applicable: The unit did not perform any line conditioning for overvoltage condition. N/A\*\*—Not applicable: This on-line unit maintains constant output despite input-voltage variation. N/A†—Not applicable: The product does not have this feature.

percent. The Minuteman XRT 2000 provided the best overall THD for line-interactive units: under 3 percent. Despite these findings, we noted no adverse effects on any of our test loads due to the varying THD levels.

The jury is still out on the importance of THD. Some experts say high THD levels may cause electrical noise and possible data errors in a computer. They contend that a noisy signal is liable to generate undue heat when the UPS provides power to switching power supplies. Others argue that high THD levels present no danger to the load, because internal filters in the power supply are naturally equipped to deal with such voltage pulses. Most vendors admit, however, that linear loads might be adversely affected by a higher THD.

We found no scientific studies to support either viewpoint. Although we favor sine waves philosophically, independent experts say that even square waves pose no problem for PC power supplies over the brief duration that a line-interactive device generates power from its internal batteries.—*Analysis written by Jeff Mace*

## How We Tested

All tests were conducted with each UPS loaded to 75 percent of its rated capacity. To obtain an exact load, we added a resistive power draw of incandescent light bulbs ranging from 40 to 150 watts and two modems using one transformer block. Each server was an HP NetServer 5/66 with five 1.2GB hard disks and 64MB of RAM. We used Microsoft Windows NT Server 4.0. To provide utility power to

each UPS, we used a three-phase wired Elgar SW5250, a programmable AC/DC power source. The Elgar unit let us simulate both stable and fluctuating utility power, including simulated blackouts, brownouts, and overvoltages.

For the **Brownout** tests, we set the Elgar to provide a constant 120 volts to each unit. We measured the UPS output voltage with a voltmeter and observed the input and output voltages reported by the software. Next, we decreased the voltage by 0.5-volt increments until we triggered a power event, which indicates the first sign of power conditioning.

For the **Blackout** test, we decreased the voltage until the UPS switched completely to battery power, and we noted any power-boosting events as they occurred.

To measure battery rundown time, we fully charged the battery, then set

the software to allow a full battery rundown. We attached an electric clock to the UPS, then disconnected power to the unit. The clock measured the battery runtime.

For the **Overvoltage** tests, we increased utility power in 0.5-volt increments until a bucking power event occurred. We recorded each successive power event until the unit switched over to battery power.

For the **THD** test, we tested the total harmonic distortion of UPS output for both standard pass-through (or conditioned) utility power on line-interactive units and battery output for all the units. We used a Dranetz 8000 Power Analyzer to perform the test. The Elgar provided very clean power to each UPS, with less than 1 percent THD.

varying levels of input power. Both delivered excellent runtimes on our Blackout test, the LI1420U with just under 11 minutes and the LI2KH with 15 minutes 20 seconds. On our Brownout tests, both switched to battery power at about 105 volts. They handled overvoltage events differently, however. When input power reached 127 volts, the LI1420U began to condition the power down, then switched to full battery when input reached 140.5 volts. The LI2KH did not supply overvoltage conditioning, but switched to full battery power at 134.3 volts.

An external SNMP unit (\$399 Ethernet, \$1,495 Token-Ring) is available to provide remote UPS configuration and SNMP monitoring, as is an external monitoring unit called EnvironCom (\$289 list) that monitors temperature and humidity. Though additional batteries are not offered, the Fortress LI1420U and LI2KH have plenty of bells and whistles that deserve serious attention.—*Padraic Boyle*  
**Fortress LI1420U.** Street price: \$650. **Fortress LI2KH.** Street price: \$990. Best Power, Necedan, WI; 800-356-5794, 608-565-7200; [www.bestpower.com](http://www.bestpower.com). Circle 471 on reader service card.

Deltec Network Systems Group

**PowerRite Pro II**

Exide Electronics Group Inc.

**NetUPS SE**



With boost and buck line conditioning, load shedding, hot-swappable batteries, and robust software, Deltec Network Systems Group's PowerRite Pro II is both an innovation and a bargain at \$1,000 (street). Deltec's parent, Exide Electronics Group, sells the same hardware as the NetUPS SE. These are the best UPSs in this







FROM A CLINICAL PERSPECTIVE, *every case is different. But one thing that every birth has in common is the wonder and amazement of bringing another human being into the world. And no matter how many babies you deliver, that never changes. Not even for Dr. Linda Heffner (opposite) of Boston's Brigham and Women's Hospital who sees over 700 difficult pregnancies a year, and is still moved.*



**There is no such thing as a crystal ball. However, those seeking the future can still find it in a piece of glass.**



PREGNANCY IS A MIRACLE. *At times, though, it's not without a degree of risk. Thankfully, modern medicine and technology can help. For example, ultrasounds allow doctors and nurses to assess how babies are doing in the womb, and to see potential problems.*





**ULTRASOUND TECHNOLOGY** and a **MultiSync LCD monitor** from **NEC Technologies** allow doctors and nurses to see anatomically, take important measurements, and observe the many behaviors of the fetus in the uterus. This capability takes on even greater importance in the evaluation of complicated pregnancies, and it has given the medical community a tremendous wealth of information that is critical to obstetric research.



**NEC MultiSync LCD2000**  
20.1" Viewable LCD Monitor

How do you see where the eye cannot? How do you answer the questions of an expectant mother and father? With ultrasound technology and a MultiSync liquid crystal display monitor from NEC Technologies.

These monitors take up 60% less space and weigh 70% less than traditional monitors. So you'll find that they fit easily in exam rooms and on diagnostic carts, where space is at a premium.

XtraView™ technology allows you to see the screen clearly from virtually any angle. They produce a brighter, sharper image than many CRTs, plus they eliminate eye-fatiguing

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At NEC Technologies we're committed to creating products that set the standard. In fact, the MultiSync LCD2000 is the very first commercially available 20.1" viewable LCD monitor in the world.

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Expect more. Experience more.



**DR. LINDA HEFFNER** is Director of Maternal-Fetal Medicine at Boston's Brigham and Women's Hospital, which recently opened a state-of-the-art birthing unit geared to the comfort of families. Dr. Heffner is at the forefront of high risk obstetrics. As such, she and her colleagues evaluate how and why fetuses grow in the womb, to try to give each one the very best possible odds for a safe and healthy delivery.

| MultiSync® LCD Series | LCD2000™                         | LCD400™            |
|-----------------------|----------------------------------|--------------------|
| Viewable Size         | 20.1"                            | 14.1"              |
| Maximum Resolution    | 1280 x 1024                      | 1024 x 768         |
| Weight                | 22.0 lbs                         | 11.5 lbs           |
| Dimensions (W, H, D)  | 19.7 x 19 x 8.7"                 | 14.1 x 14.3 x 6.7" |
| Brightness            | 150 cd/m²                        | 180 cd/m²          |
| Viewing Angle         | 160° conical XtraView technology |                    |
| LCD Type              | Active matrix                    | Active matrix      |

Both models are compatible with PC, Mac, workstation or any VESA compliant analog RGB signal, no special card required



## MULTISYNC LIQUID CRYSTAL DISPLAY monitors

are ideal for ultrasounds. They deliver bright, sharp images, and they also have a much smaller footprint, which means that these monitors fit easily on diagnostic

carts and in exam rooms.





## Uninterruptible Power Supplies

roundup, and win our Editors' Choice.

Each of the PowerRite/NetUPS twins comes with a pair of software packages with nearly identical features: FailSafe III is a standalone version, while LanSafe III supports network servers and can monitor and control remote UPSs over a LAN. The software offers excellent control and monitoring tools via detailed graphical displays. The load-segment feature divides the eight output receptacles into three grids, allowing you to place critical components (such as the CPU) and nonessential components (such as the monitor) on different grids. The units support load shedding, which lets you preset the grids' shutdown order.

Our Blackout test illustrated just how handy load shedding can be. After run-

ning on battery power for 5 minutes, load shedding let us decrease the load from 75 to 16 percent (just the server CPUs) and thus increase battery runtime an additional 1 hour 37 minutes. The units also performed line conditioning. On our Brownout tests, the devices used battery power to supplement incoming power down to 84.4 volts before switching to full battery power. On the Overvoltage test suite, the units bucked incoming power as high as 141.5 volts back down to 123 volts before switching to battery power.

The range of features, level of power conditioning, and attention to detail make these units worthy additions to any network.—James Karney

**PowerRite Pro II.** Street price: \$1,000. Deltec

Network Systems Group, San Diego; 800-335-8321, 619-291-4211; [www.deltecpower.com](http://www.deltecpower.com). **NetUPS SE.** Street price: \$1,000. Exide Electronics Group Inc., Raleigh, NC; 800-554-3448, 919-872-3020; [www.exide.com](http://www.exide.com). Circle 472 on reader service card.

Liebert Corp.

**PowerSure Interactive**

Liebert Corp.'s 2.2-kVA PowerSure Interactive (\$950 street) provides reliable basic power protection. While Liebert's management software, SiteNet 2 (an additional \$64 list), delivers reasonable software control, a longer battery runtime would make this product a more compelling choice.

SiteNet offers good control over UPS operation and shutdown in the event of

## Personal Powerhouses: Protecting Individual PCs

By James Karney

Entry-level UPSs are more than just watered-down versions of their 2-kVA siblings. The personal UPS market has a life all its own, as vendors scramble to hit on the right mix to inspire home and office users to look beyond inexpensive surge protectors and invest in solid power protection—even if the lights never flicker. As a result, products in the 420-VA to 450-VA range run the gamut of both features and price.

Battery size gives a good idea of how long the unit will function in a crisis, though it's not the main factor to consider when comparing models. Even the least expensive personal UPS we tested will keep an average PC running for at least 5 minutes after a blackout. Better devices provide line conditioning to protect your hardware against power fluctuations. Often, problems blamed on software or operating-system bugs can be traced to faulty power. You'll also want intuitive software that saves open files before shutting down the system.

**FIVE PERSONAL UPSs**

For a snapshot view of the current market, we put five representative 420-VA to 450-VA units through some of the

same tests as the 2-kVA units in the main story. The models each included a custom serial cable and management software, and they ranged in price from \$179 to \$339 (list). Our test system was a 133-MHz Pentium with a 17-inch monitor, a 33.6-Kbps modem, a SCSI hard disk, two 3.5-inch floppy disk drives, and an 8X SCSI CD-ROM drive. Prior to testing, we charged the UPS units for 24 hours.

**RUNTIME ON BATTERY POWER** Minutes seconds

|                              |      |  |
|------------------------------|------|--|
| APC Back-UPS Pro 420         | 6:43 |  |
| Best Power Patriot 420       | 7:03 |  |
| SL Weber UPStart Network 350 | 5:57 |  |
| Tripp Lite Smart 450 Net     | 6:53 |  |
| ViewSonic Opti-UPS 420E      | 6:27 |  |

BETTER ►

The most expensive unit in this mini-roundup, the **Back-UPS Pro 420** (\$339 list), from APC (800-877-4080; [www.apcc.com](http://www.apcc.com)), packs plenty of features to justify the cost. You get boost and buck conditioning, Windows 95 plug-and-play setup, user-replaceable batteries, four outlet receptacles, modem/network overvoltage protection for a single line, an online circuit breaker, and PowerChute pro software.

While Back-UPS gets the job done without a fuss, it does so without fancy interface graphics or a metering func-

tion, which some competitors offer. For our Blackout test, the device turned in a runtime of 6 minutes 43 seconds, and it powered down the attached devices safely. It reports battery and basic line conditions, configures alerts, and performs preprogrammed shutdown tests.

On the other end of the price spectrum is the **Patriot 420** (\$179 list), from Best Power (800-356-5794; [www.best-power.com](http://www.best-power.com)). Designed for the bargain hunter looking for adequate runtime and little else, the Patriot 420 lasted just over 7 minutes on our Blackout test, the longest here. However, a list of shortcomings might cause a more selective shopper to overlook it.

The Patriot sports just two outlets, and the custom cable doesn't come with the package; Best will send it to you on receipt of the software request card. In addition, Best's software, CheckUPS II, was the most limited we tested. The four alerts ("UPS normal," "low battery," "on battery backup," and "weak battery") and other status messages are handled through a single window. Even so, the unit shut down the system during a blackout without a hitch. For overvoltage protection, the Patriot uses a fuse. A spare is included, but to replace it

*Continues*

# Hey. What have you got to lose?

**POWER DISRUPTIONS** destroy valuable equipment and data every day. And if you believe a standard surge protector or UPS solution will protect you, well, you're in the dark.

That's why PK Electronics has introduced the new BlackoutBuster,<sup>™</sup> the only desktop UPS powerful enough to protect your entire system.

Only BlackoutBuster features four outlets offering full battery backup for everything from your Pentium PC to your color monitor, zip drive and laser printer, as well as two more for surge suppression, plus Internet line protection. And



PK Electronics software will automatically close down your Microsoft (Windows or NT) applications and files if you're not around. And it's all backed up with a full three-year warranty, with a six year option, plus a \$30,000 guarantee for your connected equipment.

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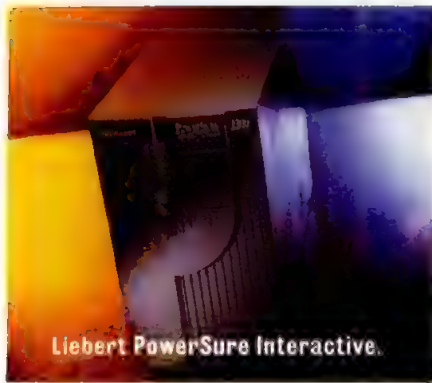
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Laser printer on  
page 21 of  
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## Uninterruptible Power Supplies



power failure. The Power Flow tab shows the current power conditions, whether the battery is engaged or charging, and the temperature. You can configure alerts to be sent via network broadcast message or

pager, and you can schedule UPS self-tests.

The software performed properly during testing, and the battery and line-conditioning events gave solid results. On our Overvoltage tests, the unit effectively bucked the voltage increases between 132.5 and 140.5 volts, at which point it switched over to battery power. On our Brownout tests, the unit switched over to full battery power at 90.2 volts—not the best score, but good. On the Blackout test, however, the software shut down the server properly but cut off battery power after only 6 minutes 20 seconds, with 52 percent of the charge remaining—the shortest runtime in this roundup. Liebert argues that saving some charge is wise in case of a rolling blackout. We would still

prefer to see more runtime from this otherwise solid, well-behaved unit.—JK

**PowerSure Interactive.** Street price: \$950. Liebert Corp., Columbus, OH; 800-877-9222, 614-841-6022; [www.liebert.com](http://www.liebert.com). Circle 473 on reader service card.

## MGE UPS Systems

**Pulsar EX20**

MGE UPS Systems' 2-kVA Pulsar EX20's claim to fame is on-line UPS protection at a line-interactive price. Indeed, at \$1,250 (street), the Pulsar is less than half the price of the other on-line unit we saw, the Toshiba 1400SE (\$2,800 street). The Pulsar is a good performer; our only quibble is that its software was not always in sync with what was actually happening with the hardware.

The Pulsar houses one battery; you can add batteries to extend runtime by up to 45 minutes. MGE's management software,



Solution Pac, can be used via a serial port or remotely with an optional SNMP adapter kit (\$415 list, Ethernet only). The graphical interface was useful, but the gauges were loosely synchronized with the hardware environment; readings from the input gauge were often delayed from 30 seconds to a minute as we changed the incoming voltage. Other monitoring features include an environmental sensor for measuring air temperature and checking for water conditions (\$329 list)—useful for monitoring a remote location.

The Pulsar handled our power events unflinchingly. On our Brownout and Over-voltage tests, it delivered a continuous flow of 120 volts to the attached devices. On our Blackout test, it yielded an excellent 19 minutes 11 seconds of runtime, just a few ticks behind the leading unit, the APC Smart-UPS 2200. The Pulsar EX20 is a fine choice, and a bargain

*Continued*

you need to open the case.

SL Waber's **UPStart Network 350** (\$199 list; 800-634-1495; [www.waber.com](http://www.waber.com)) may have *network* as part of its name, but the design is definitely standalone. The lowest-voltage unit in the roundup, its under-6-minute runtime on our Blackout test was no surprise. The back of the unit provides two backup and two surge protection outlets, modem-in and -out power filtering, a circuit breaker, comm connection, and an audible alarm.

Checking the battery status is somewhat primitive: Unplug the UPS and if all the LEDs are dark, it's time for a new battery. We did like the management software, Electronic Bookmark, which handles basic alert functions, manages a shutdown, keeps an event log, and saves open files before powering down the system. You can even set it to return your desktop to its pre-power-down state, complete with open applications and files, once the power returns.

Tripp Lite's **Smart 450 Net** (\$369 list; 312-755-5401; [www.tripplite.com](http://www.tripplite.com)) is a lower-voltage version of its higher-end siblings. It offers line conditioning, plug-and-play setup under Windows 95, and four power outlets. Power Alert Plus software reports 15 status conditions using an easy-to-read graphical interface with tables and bar graphs. It lacks a display of voltage being applied

to the attached devices, though. On our Blackout test, the Smart 450 Net turned in the second-best runtime—just under 7 minutes—and safely shut down the system as programmed.

For overall value, it's hard to beat the ViewSonic **Opti-UPS 420E** (\$200 street; 800-888-8583; [www.viewsonic.com](http://www.viewsonic.com)), the best personal UPS we tested. It offers solid performance, ease of use, and some features usually found on more expensive models. It offers line conditioning and includes two outlets, RJ-11/45 modem/network-in and -out surge-protection jacks, a self-test button, an alarm, a circuit breaker, and a site-wiring-fault warning light.

Quality is evident throughout. Setup took less than 5 minutes. The Power Management Suite's GUI displays the status of the UPS, battery, runtime, and load, and even the power quality in and out of the attached devices. It let us set the high- and low-voltage transfer points, shutdown intervals, and alerts.

In a blackout, the software, Opti-Safe, shuts down the system, and it can even send alerts over a network or via e-mail and pager. It yielded a respectable battery runtime of 6 minutes 27 seconds. You can also configure it to perform automatic and remote shutdown and scheduled reboots. Though we would like to see a user-replaceable battery and a surge-only outlet for a printer in the next iteration, this model is a winner.

# Better to have a single BlackoutBuster™ than to curse the darkness.

**PK ELECTRONICS'** new BlackoutBuster is the only desktop UPS with the power and capacity to protect your entire computer system from power disruptions. Including the applications and files you're running.

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Scottsdale, AZ

"\*\*!@!\*\*\*!"



## SUMMARY OF FEATURES

## UPSs

PC MAGAZINE  
EDITORS' CHOICE

■ YES ■ NO

Products listed in alphabetical order

|                                                                              | APC Smart-UPS<br>2200              | Best Power<br>Fortress L11420U     | Best Power<br>Fortress L12KH       | Deltec PowerRite<br>Pro II,<br>Exide NetUPS SE | Liebert Power<br>Sure Interactive   | MGE Polaris EX20        | Para Minuteman<br>XRT 2000 |
|------------------------------------------------------------------------------|------------------------------------|------------------------------------|------------------------------------|------------------------------------------------|-------------------------------------|-------------------------|----------------------------|
| List/street price                                                            | \$1,429 / \$1,060                  | \$999 / \$650                      | \$1,599 / \$990                    | \$1,210 / \$1,000                              | \$1,690 / \$950                     | \$1,545 / \$1,250       | \$1,699 / \$1,400          |
| UPS type                                                                     | Line-interactive                   | Line-interactive                   | Line-interactive                   | Line-interactive                               | Line-interactive                    | On-line                 | Line-interactive           |
| Input voltage/type of wall plug                                              | 120 / 5-20P                        | 120 / 5-15P                        | 120 / L5-30P                       | 100-127 / 5-20P                                | 120 / L5-30P                        | 120 / 5-15P             | 120 / L5-30P               |
| Number of 120-volt/220-volt/089 outlets                                      | 8 / 0 / 1                          | 6 / 0 / 1                          | 6 / 0 / 1                          | 8 / 9 / 1                                      | 8 / 0 / 1                           | 4 / 0 / 1               | 6 / 0 / 1                  |
| Number of separately switched or fused circuits                              | 0                                  | 0                                  | 2                                  | 3                                              | 4                                   | 4                       | 3                          |
| Number of surge-protected telephone-line jacks                               | 0                                  | 0                                  | 0                                  | 1                                              | 0                                   | 0                       | 0                          |
| <b>Power Specifications</b>                                                  |                                    |                                    |                                    |                                                |                                     |                         |                            |
| Rated output capacity (VA/watts)                                             | 2,200 / 1,600                      | 1,420 / 975                        | 2,000 / 1,500                      | 1,920 / 1,400                                  | 2,200 / 1,600                       | 2,000 / 1,400           | 2,000 / 2,000              |
| Rated backup time, half load/full load (minutes)                             | 24 / 9                             | 17 / 5                             | 30 / 10                            | 24 / 9                                         | 12 / 5                              | 18 / 10                 | 36 / 12                    |
| External batteries accepted                                                  | Up to 10                           | None                               | None                               | None                                           | None                                | Up to 2                 | Unlimited                  |
| Battery recharge time (hours)                                                | 2                                  | 5                                  | 3-12                               | 3                                              | 3                                   | 2-3                     | 4                          |
| Battery shelf life (years)                                                   | 3-6                                | 3-6                                | 3-6                                | 3-6                                            | 5                                   | 5                       | 4-5                        |
| User-changeable/hot-swappable batteries                                      | ■ ■                                | ■ ■                                | ■ ■                                | ■ ■                                            | ■ ■                                 | ■ ■                     | ■ ■                        |
| Total rated surge protection (joules)                                        | 480                                | 300                                | 300                                | 640                                            | 150                                 | 240                     | 480                        |
| UL 1449-approved for spike protection                                        | ■                                  | ■                                  | ■                                  | ■                                              | ■                                   | ■                       | ■                          |
| Mean time between failure (MTBF) rating, in hours                            | 1.2 million                        | 341,000                            | 341,000                            | 200,000                                        | 100,000                             | 100,000                 | 100,000                    |
| <b>Software Features</b>                                                     |                                    |                                    |                                    |                                                |                                     |                         |                            |
| UPS management software (price)                                              | PowerChute plus (included)         | CheckUPS II (included)             | CheckUPS II (included)             | LanSafe II/FailSafe III (included)             | SiteNet 2 (\$64)                    | Solution Pac (included) | Sentry Software (\$35)     |
| Remote reboot of servers                                                     | ■ ■ ■                              | ■ ■ ■                              | ■ ■ ■                              | ■ ■ ■                                          | ■ ■ ■                               | ■ ■ ■                   | ■ ■ ■                      |
| Network/e-mail/phone page alert                                              | ■ ■ ■                              | ■ ■ ■                              | ■ ■ ■                              | ■ ■ ■                                          | ■ ■ ■                               | ■ ■ ■                   | ■ ■ ■                      |
| Web/telephone access                                                         | ■ ■ ■                              | ■ ■ ■                              | ■ ■ ■                              | ■ ■ ■                                          | ■ ■ ■                               | ■ ■ ■                   | ■ ■ ■                      |
| Automatic/scheduled load shedding                                            | ■ ■                                | ■ ■                                | ■ ■                                | ■ ■                                            | ■ ■                                 | ■ ■                     | ■ ■                        |
| User-settable switchover/time-out parameters                                 | ■ ■ ■                              | ■ ■ ■                              | ■ ■ ■                              | ■ ■ ■                                          | ■ ■ ■                               | ■ ■ ■                   | ■ ■ ■                      |
| Automatic graceful shutdown of server applications (such as Notes or Office) | ■                                  | ■                                  | ■                                  | ■                                              | ■                                   | ■                       | ■                          |
| <b>Miscellaneous</b>                                                         |                                    |                                    |                                    |                                                |                                     |                         |                            |
| Hazards detected by UPS add-on                                               | Water, temperature, fire, security | Temperature, user-definable alarms | Temperature, user-definable alarms | None                                           | Water, temperature, smoke, humidity | Water, temperature      | None                       |
| Dimensions (HWD, in inches)                                                  | 17.0 x 7.7 x 21.5                  | 8.3 x 7.0 x 17.0                   | 17.3 x 0.0 x 20.0                  | 8.8 x 7.0 x 17.1                               | 13.2 x 7.8 x 20.1                   | 13.0 x 7.6 x 17.0       | 10.0 x 8.8 x 19.5          |
| Warranty (years)                                                             | 2                                  | 2                                  | 2                                  | 2                                              | 2                                   | 2                       | 2                          |
| Toll-free technical support                                                  | ■                                  | ■                                  | ■                                  | ■                                              | ■                                   | ■                       | ■                          |
| Technical-support hours (eastern time)                                       | 24 hours, 7 days                   | 24 hours, 7 days                   | 24 hours, 7 days                   | 8:00-8:00 M-F                                  | 24 hours, 7 days                    | 10:00-8:00 M-F          | 9:00-8:00 M-F              |
| Web address                                                                  | www.apc.com                        | www.bestpower.com                  | www.bestpower.com                  | www.deltecpower.com                            | www.liebert.com                     | www.mgeups.com          | www.minuteman-ups.com      |

for IS managers sold on the benefits of a true on-line UPS.—PB

**Pulsar EX20.** Street price: \$1,250. MGE UPS Systems, Costa Mesa, CA; 800-523-0142, 714-557-1636; www.mgeups.com. Circle 474 on reader service card.



Para Systems Inc.

### Minuteman XRT 2000

The 2-kVA Minuteman XRT 2000 (\$1,400 street), from Para Systems, provides scalable, line-interactive power protection that grows with your needs. Though more expensive than competing units reviewed here, the XRT 2000 offers stable power and a good feature set.

The management software, Sentry (\$35), graphically displays the current status of input and output power and battery life, though its output report was sometimes inaccurate. It let us schedule battery cycling tests for off-hours and configure alerts to be broadcast over a network, via pager, or by e-mail.

On our Blackout test, the unit yielded a

runtime of 7 minutes 20 seconds, one of the shortest battery lives we saw. You may want to consider adding the stackable battery packs, which come in 17-amp (\$399 list) and 90-amp models (\$1,499). On the upside, the XRT 2000 delivered a clean output signal that varied only slightly during the Brownout and Overvoltage tests. In addition, the XRT was one of only three units we tested that performed a second stage of power conditioning during the Brownout and Overvoltage tests. It was also the sole unit to feature a built-in environmental temperature monitor.

For remote monitoring, SNMP management capabilities are available as external kits for Token-Ring and Ethernet (\$599 list for the one-port version, \$1,399 list for the four-port version). Strong, stable per-



## Uninterruptible Power Supplies

Toshiba International Corp.

## Toshiba 1400SE

One of two on-line UPSs in this review, the Toshiba 1440SE (\$2,800 street) exhibited rock-solid continuous-voltage and battery-expansion capabilities, for a runtime of up to 4 hours. But the high price and scanty software—PowerView Plus, a \$119 option—left us mildly disappointed.

The batteries are not user-replaceable, though they have a rated life of seven years, double that of most in this review. To augment runtime, you can add a connector (\$300 list) for attaching external battery packs (\$678 list for 30 minutes of power, \$2,579 for up to 4 hours).

We found the PowerView Plus software limited. It let us configure alerts to be broadcast over the network or sent via pager or e-mail, but PowerView lacks a battery runtime indicator. Instead, it displays a less useful battery voltage measurement. Also, the program exhibited a frustrating 30-second polling delay.

In testing, the unit delivered a continuous and uninterrupted 117.5 volts in power events ranging from a blackout to a 150-volt surge. But the single circuit breaker—designed to protect against input overloads—proved to be its Achilles' heel. On our Brownout tests, the 1440SE's breaker tripped with loads above 65 percent (forcing the unit to drop utility power that would normally charge the battery), and it had to be reset manually. In unattended operation, this could bring down the network until someone arrived on site. The Toshiba 1440SE ranks as a reasonable choice where power quality is the primary concern and software features and price are not.—**WR**

**Toshiba 1400SE.** Street price: \$2,800. Toshiba International Corp., Houston; 800-231-1412; 713-466-0277, [www.tic.toshiba.com](http://www.tic.toshiba.com). Circle 476 on reader service card.

Tripp Lite  
Smart 2200 Net

The Tripp Lite Smart 2200 Net (\$1,000 street) is a no-nonsense 2.2-kVA unit that delivers reliable power with solid buck and boost operation, easy setup, and support for all major OSs and networks.

The package includes Power Alert Plus for management, which we found painless to install and intuitive to use. The graphical interface is divided into two windows; the

left side lets you configure up to 7 of the possible 15 items tracked by the power monitor, such as battery condition and voltage. The right side displays bar graphs that can illustrate input voltage, output load, battery capacity, frequency, and temperature, all of which can be captured in a log file. Unfortunately, the software doesn't display or record the output voltage.

Power Alert Plus lets you configure a variety of alerts and have them sent as network broadcast messages or via e-mail or pager. Notably, the software has the ability



to pool all alerts from supported (Tripp Lite and APC) UPSs on the network into a single file for review. We found it easy to customize message content and tailor it to indicate which system was acting up.

The Smart 2200 Net performed admirably on our tests. During the Brownout tests, it boosted power effectively and completely switched over to the battery only when input power dipped to 85.3 volts. The Blackout test yielded a battery runtime of 12 minutes 15 seconds, during which Power Alert Plus properly shut down the networks and transmitted the preset alerts.

Note that the battery charges constantly, even during brownouts. This keeps the UPS ready for a crisis, but if you unplug it while it's running on, the battery will drain completely—even if no devices are plugged in. Also, you'll need an add-on, Power Administrator 800 (\$999 list), for SNMP and load-shedding. Though the software lacks advanced features, the Smart 2200 Net handles its job well. Reliable and easy to maintain, it's one UPS you can count on.—**JK**

**Smart 2200 Net.** Street price: \$1,000. Tripp Lite, Chicago; 312-755-5401; fax, 312-644-6505; [www.tripplite.com](http://www.tripplite.com). Circle 477 on reader service card. **PC**

| Toshiba 1400SE                                               | Tripp Lite Smart 2200 Net                                |
|--------------------------------------------------------------|----------------------------------------------------------|
| \$3,049 / \$2,800                                            | \$1,199 / \$1,000                                        |
| On-line                                                      | Line-interactive                                         |
| 120 / 15-20P                                                 | 120 / 5-20P                                              |
| 4 / 0 / 4                                                    | 6 / 0 / 3                                                |
| 4                                                            | 1                                                        |
| 0                                                            | 2                                                        |
| 2,000 / 1,400                                                | 2,200 / 1,700                                            |
| 30 / 10                                                      | 31 / 13                                                  |
| Up to 4                                                      | Up to 10                                                 |
| 8                                                            | 2-4                                                      |
| 7                                                            | 4-6                                                      |
| 95                                                           | 480                                                      |
| 200,000                                                      | 400,000                                                  |
| PowerView Plus (\$119)                                       | Power Alert Plus (included)                              |
| None                                                         | Water, temperature, humidity, fire, security             |
| 14.6 x 10.0 x 25.5                                           | 16.5 x 9.0 x 12.3                                        |
| 3                                                            | 2                                                        |
| 24 hours, 7 days                                             | 8:00-7:00 M-F                                            |
| <a href="http://www.tic.toshiba.com">www.tic.toshiba.com</a> | <a href="http://www.tripplite.com">www.tripplite.com</a> |

formance and a rich feature set make the XRT 2000 worthy of consideration.—**PB**

**Minuteman XRT 2000.** Street price: \$1,400. Para Systems Inc., Carrollton, TX; 800-238-7272, 972-446-7363; [www.minuteman-ups.com](http://www.minuteman-ups.com). Circle 475 on reader service card.





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# PC Tech

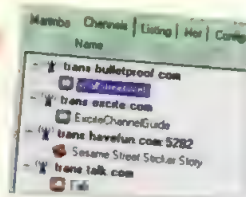


## INSIDE

**TUTOR:** The millennium bug could mean disaster, and there's a good chance it will affect you. *Page 229*



**OPERATING SYSTEMS:** Clustering will ease the frustration of server failures in the next version of Windows NT. *Page 235.*



**INTERNET TOOLS:** No newspaper carrier can deliver personalized news and information right to your desktop, but push technology will. *Page 245.*

**POWER PROGRAMMING:** CORBA lets you build applications with distributed objects that work across platforms. *Page 241.*



**SOLUTIONS:** Personalize your system with an OEM logo and support information, create pages of labels in Microsoft Access, and much more. *Page 251.*



## The 1997 PC Magazine Shareware Awards

*JASC's Paint Shop Pro, a powerful image editor, is the overall winner in this year's competition.*

By Sheryl Canter

The editors of *PC Magazine* evaluated 54 finalists in 11 categories in the fourth annual Ziff-Davis Shareware Awards and chose Paint Shop Pro 4.12, from JASC, as this year's Program of the Year. The winner in the "Graphics & Multimedia Tools" category, Paint Shop Pro—a bitmap-editing program—offers a wide range of intelligently selected tools designed for ease of use, and it has become a standard for creating online images.

The awards honor the best PC-based shareware released or significantly upgraded in the past year. All such programs available from the ZDNet Software Library ([www.hotfiles.com](http://www.hotfiles.com)) were entered into the competition automatically and reviewed by ZDNet editors, who selected the finalists. Winners were announced June 26, 1997, at the Shareware Industries Confer-

ence in Warwick, Rhode Island. For a list of the finalists and winners in each category, see the sidebar "PC Magazine Finalists: 1997 ZD Shareware Awards."

### BEST OF THE BEST

It wasn't long ago that only print-shop professionals would use a program with the capabilities of Paint Shop Pro. But in this world of affordable digital cameras and ubiquitous Web pages, people of all descriptions are taking an interest in image manipulation. Digital cameras do not yet provide the resolution and creative control of film cameras, but they do make it especially easy to get an image into your computer, where you can correct many of the image's shortcomings.

Version 4.12 of Paint Shop Pro, which runs under Windows 95 or Windows NT 4.0, adds a variety of powerful new features that aid in

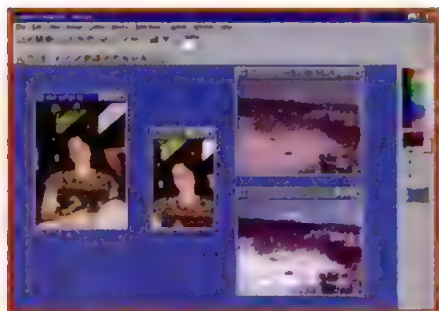


photo retouching and high-end image manipulation. One capability common in film cameras but lacking in their digital counterparts is double exposure. But this handicap is easily overcome using Paint Shop Pro, because combining digital images is exceptionally easy and offers much more flexibility than the traditional method.

Digital images are represented by a grid of colored pixels. The color of each pixel is determined by the proportion of red, green, and blue light it contains. These *RGB values* can range from 0 to 255, with 0 representing no color and 255 representing full saturation. You can overlay two images by mathematically combining the corresponding RGB values of each pixel. Paint Shop Pro 4 offers six different mathematical functions for combining images: Add, Subtract, Multiply, Difference, Darkest, and Lightest. All give you a combined image, but the colors look different with each function.

## PHOTO RETOUCHING

Maybe you have a photograph that didn't scan well—maybe it lacks contrast, or the background is a tad overwhelming, or everything looks green. Paint Shop Pro can correct all these problems. Two portraits are shown in Figure 1, with the original on the left and the retouched version on the right.

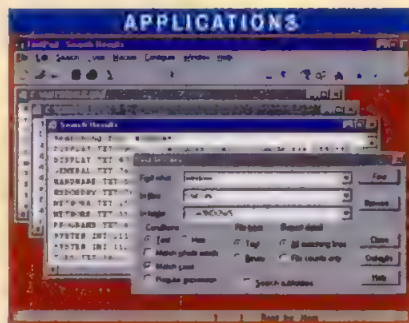


**FIGURE 1:** Color adjustments applied selectively to parts of a photograph can correct composition problems such as a too-dark background on a portrait. Global adjustments can bring new life to a low-contrast, color-distorted landscape.

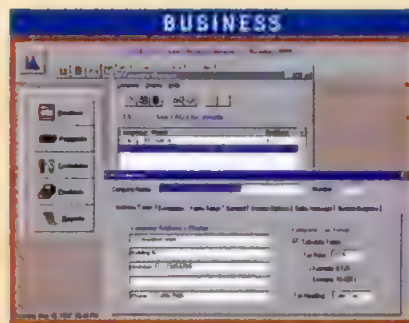
The original image is not well framed, and the background is too dark. In a matter of minutes, tools in Paint Shop Pro let us crop the image and lighten the background so it doesn't compete with the head. The techniques we used demonstrate several features of Paint Shop Pro.

First we selected the part of the photograph we wanted to keep, pressed Ctrl-C to copy it to the Clipboard, then chose Edit | Paste | As New Image. This created the cropped version. We used the zoom tool to blow up the image to twice actual size, and we

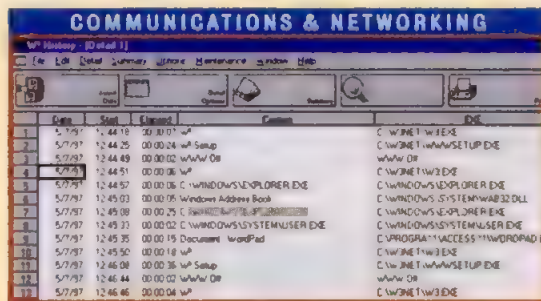
## Winners' Circle: PC Magazine's



**TEXTPAD** is a classic text editor with loads of features that just keeps getting better. Its especially powerful search facility constitutes a utility all its own.

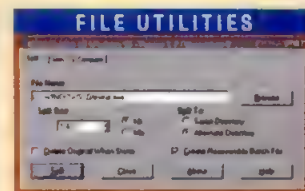
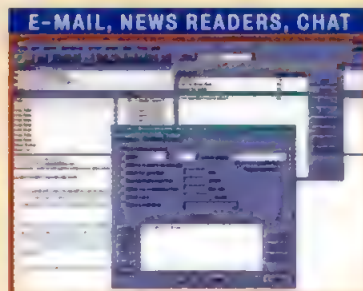


**FF BILLING MANAGER PRO** is a richly featured and attractively designed system for generating invoices, billing statements, mailing labels, and form letters.



**WINWHATWHERE 97 FOR NETWORKS** is a unique data-gathering tool that lets employers monitor the programs employees use, how many times they click the mouse or press a key, and even what Internet sites they visit. It can even provide data you can use for ergonomic studies to help prevent repetitive motion syndrome.

**ANAWAVE GRAVITY** is a feature-packed news reader with HTML message support, a customizable spell-checker, numerous filtering options, off-line reading, a flexible user interface, and much more.



**MASTERSPLITTER's** strength is in a straightforward interface that makes it fast and simple to break large files into manageable pieces and then put the pieces back together.

used the freehand selection tool to select the background. We then saved our selection in case we needed to select and modify the same area again. This convenient feature is new with version 4.12.

In this case, making the selection was straightforward, but sometimes it's easier to select the parts you *don't* want and then invert the selection. Paint Shop Pro lets you do this. Another powerful new feature is the ability to select multiple areas at once.

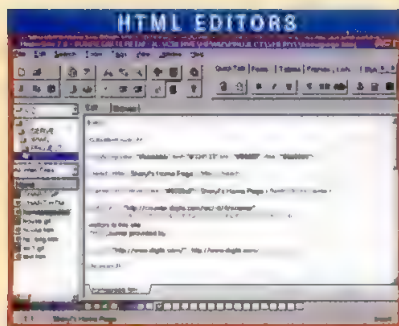
We wanted the head to look natural against the lightened background—with no harsh lines to make it look like a cutout—so we

chose Selections | Modify | Feather to blur the selection marquee. Selections can be modified in two other ways. You can change the overall opacity, and you can set the selection as a transparent color. By increasing the tolerance in the transparent-color dialog, you can make colors similar to the selected colors transparent as well. The opacity and transparency options affect only the selection, not the original image, so you don't see the effect unless you move or copy and paste the selection.

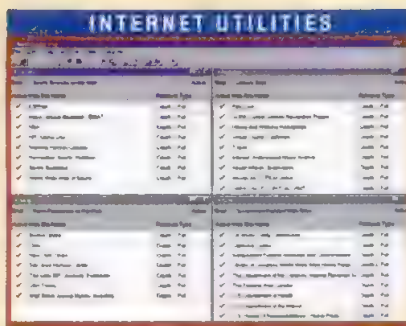
Our goal was to use the Colors | Adjust | Brightness/Contrast command to lighten the background, but it works on selected areas



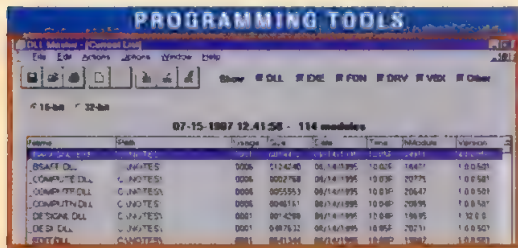
# Shareware Award Recipients



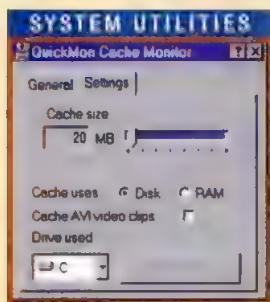
**HOMESITE FOR WINDOWS 95** is a snappy, easy-to-use HTML editor with support for advanced features such as scripting, Java, and ActiveX. It offers excellent HTML-based help.



**NETATTACHE PRO** is a very capable off-line browser that is easy to get up and running as well as easy to use. It gets the job done without a hitch.

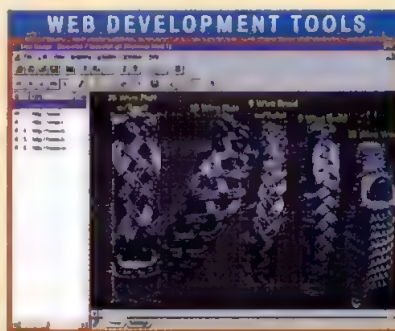


**DLL MASTER** lists the DLL, EXE, FON, DRV, and VBX files loaded in memory, giving programmers a window into the dynamic linking that is fundamental to Windows' operation and providing extensive information on currently running 16- and 32-bit tasks. Click on any program to bring up a dialog box packed with information.



**CD-QUICK CACHE FOR WINDOWS 95** speeds up CD-ROM performance by means of an intelligent caching technique.

**LIVE IMAGE** is a nicely designed little application that does one thing and does that very well: The program makes it easy to create client-side image maps for your HTML pages. Wizards walk you through the process and can even help you create some common types of graphic. The product is quick and is fully customizable.



(not on the entire image) only if the color depth is 16 million. So our next step was to select Colors | Increase Color Depth. We then brightened the selected area by 10 percent for the natural result you see.

The other photograph in Figure 1 is a shot of Vermont after a snowstorm, taken last winter by a live camera on the Web. The original (shown on top) has very poor contrast and a red cast. These problems are largely eliminated in the adjusted version, shown below the original.

We improved the photograph by using the options in the Colors | Adjust menu: Bright-

ness/Contrast, Gamma Correction, Highlight/Midtone/Shadow, Hue/Saturation/Luminance, and Red/Green/Blue. One of the great strengths of Paint Shop Pro is how easy it is to use these controls. Because a thumbnail of the image is displayed in each dialog and reflects every change, you don't need a theoretical understanding of what the controls do; you can see the results of using them in action.

## CHANNEL SPLITTING

If you want really fine control over the RGB values in an image, you can use the channel-splitting feature to create gray-scale images

that correspond to each color channel. The channel-combining capability then lets you reassemble the image.

We found another handy use of this feature—to decompose the stereo pictures of Mars, uploaded to the Web by NASA as red/blue anaglyphs, into their component gray-scale pictures (see Figure 2). If you've been longing to see the photographs in stereo but don't have red/blue glasses, here's your solution. The two gray-scale images can be viewed in stereo with a mirror (if one image is printed in reverse) or a standard stereo print viewer.

To create the gray-scale images for stereo viewing, we started with NASA's anaglyph image of the Rover, 81441\_full.jpg, and then chose Image | Channels | Splitting to break it down into its three component RGB channels. The blue and green channels, however, are actually part of the same image, so we had to recombine them. This was easily accomplished with Paint Shop Pro's image arithmetic feature. We took the average of the two images by adding them and using a divisor of 2, making sure "Clip color values"



**FIGURE 2:** The channel-splitting feature can be used to split anaglyphs from the Pathfinder Mars landing into their component gray-scale images, handy if you don't have red/blue glasses. The image on the far right is the arithmetic average of the blue and green images.

was unchecked. The result is the image on the far right in Figure 2.

Note that you can use the same process in reverse to create red/blue anaglyphs from pairs of photographs shot at the correct separation and angle. If you are interested in stereo photography and want to make stereo images that are too large for standard print viewers, Paint Shop Pro can help.

## IMAGE CREATION

In addition to its image manipulation capabilities, Paint Shop Pro offers a wide range of tools for image creation. The new features in version 4.12 include special effects, brush-based paper textures, and enhanced text handling (see Figure 3). Text that you add is



## PC Magazine Finalists: 1997 ZD Shareware Awards

Winners of the ZD Shareware Awards were announced on June 26, 1997, at this year's Shareware Industry Convention. To be eligible to win, authors had to upload a new or significantly changed shareware product to the ZDNet Software

Library ([www.hotfiles.com](http://www.hotfiles.com)) between April 1, 1996, and March 24, 1997. ZDNet editors picked the finalists from more than 5,800 entries.

Listed below are the 54 finalists in the 11 categories assigned to *PC Magazine* for final

judging. The winners in each category are shown in bold. Download links for all the finalists are available from PC Magazine Online. The Web version is at [www.pcmag.com/pctech/shareware/\\_open.htm](http://www.pcmag.com/pctech/shareware/_open.htm). On CompuServe you can type GO ZNT:CENTER.

| Program                                | Programmer or company            |
|----------------------------------------|----------------------------------|
| <b>APPLICATIONS</b>                    |                                  |
| InfoTree                               | iSBister                         |
| Notepad+                               | Rogier Meurs                     |
| Super Note Tab                         | Eric G.V. Fookes                 |
| <b>TextPad (32-bit)</b>                | <b>Helios Software Solutions</b> |
| Turbofiles                             | TurboWare                        |
| <b>BUSINESS</b>                        |                                  |
| Atrex Inventory Control 5.51           | Millennium Software              |
| Electronic Shop Assistance             | Agile Computer Enterprise        |
| <b>FF Billing Manager Pro</b>          | <b>M&amp;R Technologies</b>      |
| Office View 32                         | Len Phillips                     |
| SyTools32                              | AnvorySoft                       |
| <b>COMMUNICATIONS &amp; NETWORKING</b> |                                  |
| PagerPro                               | BM Systems                       |
| RK NetPlus                             | RK Software                      |
| <b>WinWhatWhere 97 for Networks</b>    | <b>WinWhatWhere Corp.</b>        |
| ZOC for Windows 95                     | Markus Schmidt                   |
| <b>E-MAIL, NEWS READERS, CHAT</b>      |                                  |
| <b>Anawave Gravity</b>                 | <b>Anawave Software Inc.</b>     |
| FindNews                               | Plannet Crafters                 |
| MailAlert                              | Diamond Ridge Inc.               |
| OUI Message Reader                     | Dvorak Development & Publishing  |
| Picture Agent                          | Richard Thead                    |
| <b>FILE UTILITIES</b>                  |                                  |
| Directory Compare for Windows 95       | DMG                              |
| FileKick                               | FileTrak Software Inc.           |
| <b>MasterSplitter</b>                  | <b>TomeSoft Corp.</b>            |
| Safety Net Pro                         | CT Software                      |
| Search32                               | Anet Inc.                        |
| <b>GRAPHICS &amp; MULTIMEDIA TOOLS</b> |                                  |
| Cool Edit 96                           | Syntrillium Software Corp.       |
| IconEdit Pro                           | Hagen Wieshofer                  |
| <b>Paint Shop Pro (32-bit)</b>         | <b>JASC Inc.</b>                 |
| Screen Thief 95                        | Nildram Software                 |
| VidFun                                 | Applied Insights                 |

| Program                                 | Programmer or company               |
|-----------------------------------------|-------------------------------------|
| <b>HTML EDITORS</b>                     |                                     |
| Arachnophilia                           | Paul Lutus                          |
| <b>HomeSite for Windows 95</b>          | <b>Nick Bradbury</b>                |
| HotDog Professional                     | Sausage Software                    |
| HTML Assistant Pro                      | Brooklyn North Software Works       |
| Webber 32                               | Cerebral Systems Development Corp.  |
| <b>INTERNET UTILITIES</b>               |                                     |
| inWebstigator                           | Ararat Software Inc.                |
| Linkbot                                 | Tetranet                            |
| <b>NetAttache Pro</b>                   | <b>Tympani Development</b>          |
| Surfbot                                 | Surflogic LLC                       |
| Tierra Highlights2                      | Tierra Communications Inc.          |
| <b>PROGRAMMING TOOLS</b>                |                                     |
| <b>DLL Master (32-bit)</b>              | <b>Shaftel Software</b>             |
| Jpad Java IDE                           | ModelWorks Software                 |
| Palette Express (16-bit)                | Rhode Island Soft Systems           |
| Personal Comm Library for C/C++         | MarshallSoft Computing              |
| PSobolik's GUID Generator               | Paul Sobolik                        |
| <b>SYSTEM UTILITIES</b>                 |                                     |
| <b>CD-Quick Cache for Windows 95</b>    | <b>Circuit Systems</b>              |
| IRQInfo System Interrupt Identification | Computer Telecommunications Systems |
| PGP WinFront                            | Ugali International Corp.           |
| Registry Search & Replace               | Stephen J. Hoek                     |
| Take Command/32                         | JP Software                         |
| <b>WEB DEVELOPMENT TOOLS</b>            |                                     |
| Exploit Submission Wizard               | Exploit Information Technology Ltd. |
| HTML Rename!                            | Parker & Associates                 |
| <b>Live Image</b>                       | <b>MediaTech Inc.</b>               |
| ReVol Aurora                            | ReVol Design Systems                |
| Serv-U                                  | Cat Soft                            |

placed onto your image as a selection, which makes it easy to apply special effects such as drop shadows, cutouts, or chiseling. The Deformations menu lets you distort selected text or images in a variety of ways, including creating circles, horizontal or vertical perspectives, and motion blur. You can flip a selection, rotate it, or create a mirror image of it. The "buttonize" special effect makes creating a three-dimensional drawing of a push button easy.

The flood fill tool now includes a set of gradient options—linear, radial, rectangular, and sunburst—for making attractive background patterns. The gradient shown in Figure 3 is a sunburst. Because text is automatically selected, filling it with a pattern or gradient is easy.

Another way to create interesting patterns for backgrounds or fills is using the tiling feature. First create a small image to

use as a tile. Then choose the area you want to fill and select the fill tool. One of the fill tool options is Pattern; if you click the Options box, you'll see all your open images in the "New pattern source" pull-down list. Select the tile image you created and it will be used as the fill pattern. The circle pattern shown in Figure 3 was created in this way. First we wrote the word "WOW" with the text tool, then we deformed the text into a

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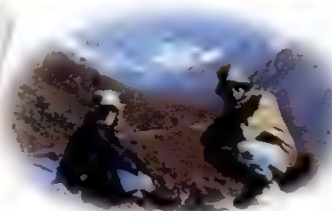
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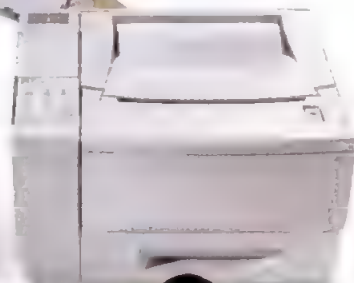
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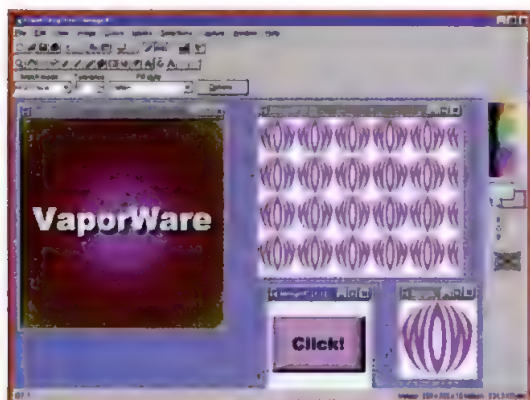
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**FIGURE 3:** Features such as gradients, drop shadows, and buttonizing add interest to previously plain text. The image deformation feature combined with the pattern fill style turns the word "VOW" into an interesting wallpaper pattern.

circular shape, and then we filled a new image using this as a pattern.

A special effect called "hot wax coating" is another way to change the appearance of an image. This effect adds layers of color with varying degrees of transparency, determined by the contours of the image. The result makes the image look as though it was dipped in hot wax.

Another handy feature new to version 4.12 is the use of paper textures, which you access through the airbrush tool. A large number of presets are built into the product, including sidewalk, wood grain, clouds, mist, polka dots, and bricks—29 in all. And if these are not enough for you, it's easy to create your own. The release notes explain how.

## FINE-TUNED CONTROL

As we mentioned earlier, one way to limit where effects are applied on an image is to use selections. When an area is selected, you can't paint outside of it, and if you are working in 16 million colors, effects will be applied only to selected areas. Also, selections can be "stan-

dard" or "floating." A floating selection is actually a separate image that appears above the parent image. If you move or process a floating selection, you are modifying only the selection, not the underlying image. A standard selection, in contrast, is part of the image. If you apply changes to a standard selection, you are modifying the image itself.

Another method of restricting where effects are applied is masking, also new with version 4.12. Masks, which are monochrome images that are the same sizes as the images they affect, work by filtering how much of an applied effect will "get through" to the image. Wherever the mask is pure white, 100 percent of the effect will

get through; wherever it is black, none of the effect will get through. Where it's gray, you'll see a partial effect. Masks don't affect the painting tools—just the effects available on the Image and Color menus.

Paint Shop Pro supports



more than 30 raster image formats. A batch mode makes it easy to convert the formats of many files at once. The program's screen capture feature lets you set delays and optionally save the cursor along with the screen.

Paint Shop Pro's rich feature set competes with those of high-end programs costing ten times as much, such as Adobe Photoshop, but its special niche is ease of use. This value is demonstrated in its implementation of paper textures entirely through presets. The company chose not to include a direct interface for modifying intensity and flow rate, because this would be less user-friendly.

The targeting of power users rather than professional printers is also evident from the program's lack of CMYK support, which is necessary for creating color separations for printing. Although planned for a later release, CMYK support was not included in version 4.12 because until recently JASC felt that only print shops would be interested in using this feature.

If anyone has the idea that shareware means lower quality, a program like Paint Shop Pro should put the idea immediately to rest. Its intelligently chosen and well-designed feature set makes it tops in its category. JASC has chosen to market Paint Shop Pro as shareware because the company believes in "try before you buy" and wants happy customers. So try Paint Shop Pro if you haven't already. And if you like it, register it! Keep the shareware tradition alive. **Paint Shop Pro 4.12.** List price: \$69. Requires: 486-based PC or better (Pentium recommended), 5MB hard disk space, 8MB RAM (16MB recommended), Microsoft Windows 95 or Windows NT 4.0. JASC Inc., Eden Prairie, MN; 800-622-2793; [www.jasc.com](http://www.jasc.com). Circle 441 on reader service card.

*Sheryl Canter is a contributing editor of PC Magazine and the editor of the Utilities column.*

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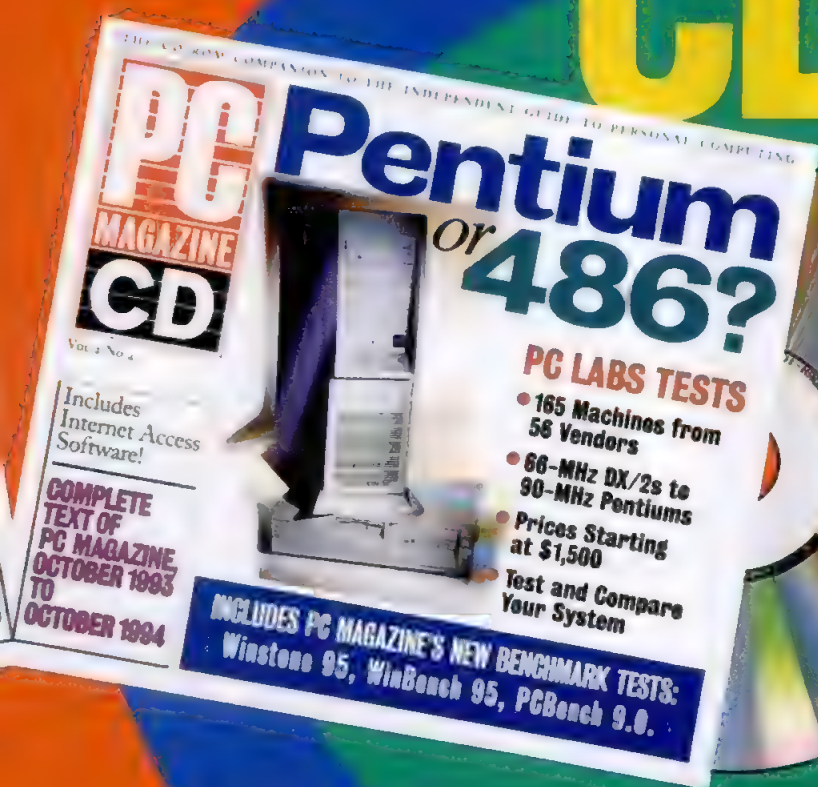
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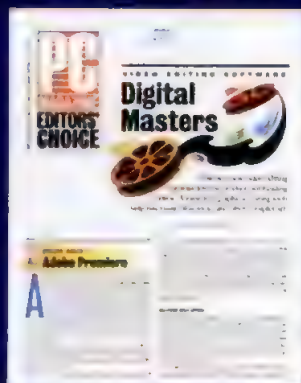
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## Welcome to the Millennium

*When the time bomb goes off, where will your data be? Here's why it could be left stranded in the past.*

By Neil Randall

Unlike the calendar purists, computer people don't care that the next millennium doesn't actually start until the year 2001. As far as they're concerned, January 1, 2000, will bring enough of a hangover. That's the day the millennium bomb goes off, when the Y2K problem rears its ugly head.

Millennium bomb? Y2K? The first sounds like a fancy frozen cocktail from one of those faceless chain restaurants, the second like half of a Canadian postal code. Regardless, the facts of the matter are that no number of cocktails will help concerned IS people relax and Canada won't be nearly far enough away if they fail to solve the problem.

What problem? Well, Y2K stands for *year 2000*, which will be a troublesome one for a wide range of computers.

The tables in Figures 1 and 2 help to explain the scope of the problem. In Figure 1, events are arranged in chronological order, and the computer date—offered in the familiar format *mm/dd/yy* (month, date, year)—describes exactly when the event occurred. The elapsed time between two dates can be easily determined by subtracting the earlier date from the later.

The apparently chronological list of world history events shown in Figure 2 is more of a problem. As long as we look only at the *Computer date* column, everything looks in order. But when you move your gaze to the *Real date* and *Event* columns, you'll see a big problem. According to the way computers currently calculate dates, the drafting of the U.S. Declaration of Independence occurred *after* the assassination of John F. Kennedy, because 11/22/63 is a "lower number" (that is, an earlier date) than 07/04/76. Similarly, Armistice Day, as the computer calculates it, happened just over three years after the Battle of Waterloo, whereas 103 years really passed between the two events.

So who cares? Well, when it comes to such historical paradoxes as the idea that Armistice Day ended the Napoleonic Wars, you needn't be concerned. You don't have to use a computer to figure those out. But determining driver's license expiration dates, setting bond maturity dates, calculating compound interest, sorting database fields by

date—those are things we all care about, even if we don't know it yet. Check any document in your possession—credit card, insurance policy, whatever—and if the year is represented by two digits, the year 2000 problem may soon be yours.

### HOW DID THIS HAPPEN?

The Y2K problem (IBM refers to it as the year 2000 *challenge*, by the way) stems entirely from one simple representation. In the early days of computing, when machines could handle a very limited amount of data, engineers and programmers chose to represent calendar dates in the six-digit format *mmddyy* we're all familiar with. January 1, 1980—the date your PC's CMOS may have as its default—is represented as 010180, and Christmas Day of this year is 122597. Note that in the earliest computer representation of the date, the month, day, and year aren't separated by hyphens, slashes, or any other punctuation. That's because programmers wanted to do away with as many characters as possible in order to save space. Represent-

ing the date as *mm/dd/yyyy* would have required ten characters, where *mmddyy* takes only six. With every occurrence of the date, therefore, programmers had four extra characters to play with.

Had they chosen to use the eight-character format *mmddyyyy*, however, the Y2K problem never would have arisen. In that case, the year would have been represented in its entirety. Throughout the 20th century, the custom of omitting the "19" in the year has caused no problems, but when December 31, 1999, turns into January 1, 2000, things will change. That's when 123199 will become 010100—or perhaps something else.

Something else? Yes. The situation would at least be controllable if all computers and programs reacted the same way at the turn of the new century. But that simply will not happen. Most mainframes will treat 010100 as January 1, 1900, and that's the major issue of the Y2K problem. All sorts of date calculations may be drastically wrong: your age, your retirement date, even the number of years since the last World Series championship for the Boston Red Sox. (This year, the computer subtracts 18 from 97—1918 was the last Red Sox championship—and comes up with 79 years. In 2000, what should be 82 years will come up -18 years, when the computer subtracts 18 from 00.) True, the difficulties of the Red Sox are hardly earth-shattering, but try the same calculation on your mortgage amor-

### EVENTS IN INTERNET HISTORY

| Computer date | Real date        | Event                                                                                       |
|---------------|------------------|---------------------------------------------------------------------------------------------|
| 01/01/83      | January 1, 1983  | Transition from Network Control Protocol (NCP) to TCP/IP, officially starting the Internet. |
| 11/02/88      | November 2, 1988 | An Internet worm affects nearly 10 percent of Internet hosts.                               |
| 10/15/92      | October 15, 1992 | The number of Internet hosts surpasses 1 million.                                           |
| 10/13/94      | October 13, 1994 | The first beta of Netscape Navigator is made available on the Web.                          |

FIGURE 1: Dates falling in the same century pose no problem for computers.

### EVENTS IN WORLD HISTORY

| Computer date | Real date         | Event                                       |
|---------------|-------------------|---------------------------------------------|
| 06/18/15      | June 18, 1815     | Battle of Waterloo.                         |
| 11/11/18      | November 11, 1918 | Armistice Day; end of World War I.          |
| 09/01/39      | September 1, 1939 | German invasion of Poland.                  |
| 12/07/41      | December 7, 1941  | Attack on Pearl Harbor.                     |
| 07/01/63      | July 1, 1863      | Battle of Gettysburg.                       |
| 11/22/63      | November 22, 1963 | Assassination of President John F. Kennedy. |
| 10/14/66      | October 14, 1066  | Battle of Hastings.                         |
| 07/04/76      | July 4, 1776      | U.S. Declaration of Independence.           |
| 12/08/80      | December 8, 1980  | Assassination of John Lennon.               |

FIGURE 2: Notice in the Real date column how these events in world history are out of order when sorted by computer date.



tization. It gets very ugly very fast.

That's only part of the Y2K problem. The turn of the century may cause your PC to revert to the default date of older BIOSes, which is January 1, 1980 (01-01-80). If you've ever lost your CMOS data because of a dead battery, you are familiar with the resulting chaos. Your computer can't find its hard disk and doesn't recognize its floppy disk drive. The system date that shows as 01-01-80 (even if the full 1980 is displayed, that doesn't guarantee your BIOS actually used a four-digit year) can easily be changed either in the CMOS settings program or through DOS's TIME and DATE commands—but when the century changes, these old BIOSes may not respond to the correct time and date, instead reverting constantly to their default, 1980. (Other defaults include 1900 and 1984.) Think of what that would do to automatic archiving programs, to all those spreadsheet and database calculations, even to your file management capabilities. And if you're running your business on PCs, think of what it would do to your invoicing and accounting.

A third possible effect of the Y2K problem is that computers turning the corner on 010100 may just stop functioning, because systems that work closely with the system date have no way of interpreting that string. This problem is almost exclusively the province of older mainframes, but lots of those are still in operation, performing large and critical tasks. Big corporations and government agencies rely on old-fashioned equipment running legacy applications. If those machines don't offer accurate data to, say, the IRS, that could affect every one of us.

If by this point you are dumbfounded by the shortsightedness of the early programmers, consider that all the groundwork was laid back in the 1960s. Given the speed at

## WHOSE PROBLEM IS IT, REALLY?

The blame can be placed on the computer industry, but that doesn't mean it's entirely the industry's problem. Date representation is a global problem even without computers. The U.S. takes the *mm/dd/yy* approach, which makes sense when you consider the way most North Americans express the date: "Today is July 4, 1998," or 07/04/98. That's the standard (including the slashes separating the elements) approved by the National Institute of Standards and Technology ([www.nist.gov](http://www.nist.gov)). Canadians and Britons reverse the month and day, so they would represent the same date as 04/07/98. In some other countries, periods take the place of our slashes, and some peoples—such as the Scandinavians—start with the year, which in the case of our example would give 98-07-04, the reverse of the American system. The International Organization for Standardization, also known as ISO ([www.iso.ch](http://www.iso.ch)), has set the standard as 1998-07-04, which includes the four-digit year. Too bad programmers didn't have the foresight to use this standard, which is inherently sort-friendly and which would have prevented the Y2K problem.

You can establish alternative date formats in Windows 95 through the Regional Settings dialog in Control Panel (click on the *Date* tab and then the *Short date* arrow), but the ISO standard is not among the choices. Microsoft claims that Windows NT will handle the Y2K crossover without difficulties and also that its products are Y2K-compliant. A quick scan of Microsoft's Web site, however, reveals that the way Access and Excel—to name just two of the company's

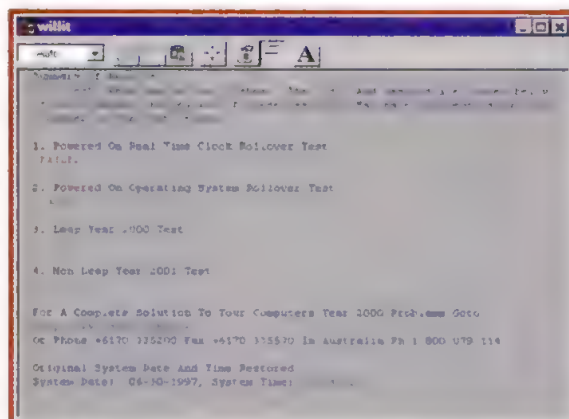
products—handle dates is sufficient cause for concern beyond the year 2000. Even within this one company, there seems to be no standard.

For the majority of PC users, having the right system date is helpful but not essential. Sure,

we might not be able to tell which version of a Word document is the most recent, and Quicken might not print our checks the day we need them. But on the whole, it's not critical. That doesn't mean, however, that PC users are immune to the millennium bomb,

even if they can bypass the BIOS date. The biggest Y2K problems are in particular applications, which may reject the new dates, mangle them in storage, or just quietly generate incorrect results. Also, most big transactions don't run on PCs, and those are the transactions that increasingly control people's lives.

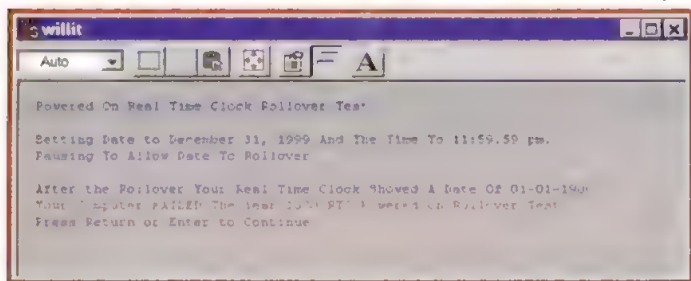
Consider the paycheck your company deposits directly into your bank account. Your company relies on its computer system for in-



**FIGURE 4:** WillIt's full report shows success with the powered-on rollover test and two leap-year tests (2000 is a leap year, and your system must take that into account).

voicing, and the invoicing and receivables systems rely on dates: invoice dates, payment-due dates, receipt dates, and so on. As the year 2000 arrives, the invoicing system fails. Invoices don't get sent out, and payments received don't get processed. Your company's cash flow grinds to a halt, and it can't take care of payables or payroll. You don't get paid, your company's creditors don't get paid, products don't get released, sales dry up... and on it goes. If you think that taking early retirement will get you past all this, remember that the system responsible for your pension check is just as much at risk.

An obvious solution would be to replace systems with hardware and software that understand four-digit years. Good idea, but the immediate cost would be enormous, and corporations and government institutions are not in the habit of looking further ahead than the next shareholders' report or election. Okay, then, how about updating existing code? Another good idea, but even medium-size companies can easily have hundreds of thousands if not millions of lines of mission-critical code they'd have to rewrite. Even that wouldn't be horrible if all date-dependent code were easy to locate, but in many instances it's not. Such code can appear throughout a program, and although the format might be standard, it may not be conventionally flagged within a program. The result is that automating changes is difficult, if not impossible, and correcting by



**FIGURE 3:** The freeware package WillIt reports that this system's real-time clock will roll over to January 1, 1990, instead of January 1, 2000.

which computing was changing, even back then, and the growing need for systems that could crunch huge assortments of numbers, it was only natural that programmers would do what was possible at the time without worrying about the distant future.



# PCTech Tutor

hand is a time-consuming, tedious (and hence error-prone) line-by-line process.

There is, of course, a great deal of money to be made helping organizations through the Y2K crisis, and you can find links to many companies offering solutions on the Year 2000 Information Center pages at [www.year2000.com](http://www.year2000.com). Browsing through their sites reveals one other disturbing fact: The millennium bomb is actually set to go off long before the next millennium. Some problems are surfacing already, as systems begin representing years beyond 2000 (new passports, bond maturity dates, and so forth). The year 1999 will offer still other problems: The digits "99" have long been used to represent an indeterminate future year. You may have encountered database applications in which, if you don't want to specify an ending date, the date field defaults to 12-12-99 or something similar. Many fields in organizational databases now carry dates like that one, and in those instances, the millennium bomb explodes on January 1, 1999, rather than a year later. And given that it's well into the second half of 1997 as you read this, you get an idea of the urgency.

#### YOUR PC AND YEAR 2000 COMPATIBILITY

Even though your PC isn't the most significant cog in the Y2K wheel, you may as well check whether it's Y2K-compliant. You can

download utilities from the Internet that will check your full system for year 2000 compliance; try [www.righttime.com](http://www.righttime.com), [www.sbhs.com/y2k/index.htm](http://www.sbhs.com/y2k/index.htm), and [www.rigel.co.nz](http://www.rigel.co.nz) for starters. You can check not only your BIOS, but also your operating system and, most important, your software applications (see Figures 3 and 4).

You can also perform your own BIOS test. Most experts recommend performing the test in DOS rather than Windows, and the safest method is to boot from a floppy disk. At the very least, boot into the command line only (press F8 when you see the *Starting Windows* 95 line, then choose *Command Line*), to ensure that no date-dependent Windows programs, such as your personal finance package, will be affected.

The first test is to set your system time and date to 23:59:59 (11:59:59 P.M.) on December 31, 1999. Do this at the command line by first typing *date* and adjusting the date, then typing *time* and adjusting the time. Wait a second or two, then type *date* and see what your machine shows. If all goes well, you'll get 01-01-2000; if not, you have a problem.

It's unlikely the test will fail, because most PCs handle a powered-on crossover just fine. More important is how the system handles the turn of the century when it's restarted. To test this, set your system time and date to

23:58 on 12-31-1999, then turn your computer off. Wait a few minutes (at least 2) and turn the PC back on. If the date is displayed as 01-01-2000, your BIOS is Y2K-compliant. If the date is displayed as 01-01-1980, or anything else, then it's not. Turn the computer off and turn it back on again, to ensure that the year holds at 2000. If so, everything's fine, at least from the BIOS standpoint.

If your BIOS test fails, your first step should be to contact your dealer and see whether a new BIOS is available for your motherboard. If your board has a flash BIOS, head for your BIOS manufacturer's Web site and see whether an upgrade is available. If all else fails, replace your motherboard with one that includes a Y2K-compliant BIOS or buy a whole new system.

Remember, even if your PC passes the BIOS test, you may not be safe. An application that isn't Y2K-compliant may crash or make a shambles of your data or simply generate erroneous results. Right now is not too soon to start bracing yourself for the millennium bomb.

*Neil Randall is a frequent contributor to PC Magazine and the author of The Soul of the Internet (ITCP) and Special Edition Using Microsoft FrontPage (Que). He can be reached at [nrandall@sprynet.com](mailto:nrandall@sprynet.com).*

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## Server Clustering

*Link multiple servers to ensure that system resources will be available to users.*

By Neil Randall

There's nothing more frustrating than trying to access a server that refuses to serve. Whether your connection is across the Internet or through your company's intranet, you need information from the server and you don't have time to wait for responses that never come. The server can fail to respond for many reasons—because of a crash, because software or hardware is being upgraded, or because it needs repairs. That may be understandable, but it doesn't help. Surely, you feel, there must be a backup system.

One backup solution long available on Unix systems will soon be available in the Windows world, in the next version of Windows NT Server. It's called *clustering*, and it involves linking multiple servers together in a manner that allows them to operate as if they were a single machine. A clustered system is transparent to users, who see no difference between a cluster and a solo server—except for the fact that down time is minimized. The principle behind the cluster is that if one server machine goes down (whether unintentionally or by design), another machine in the cluster takes over its duties within a minute or so, a process known as *fail-over*. The documents and resources that users request keep getting served, and the systems administrators can go about the business of repairing the first server's problems.

But isn't that what happens now? To a degree, yes, with a technology known as *server mirroring*. As the name suggests, server mirroring involves having identical server machines; when one goes down, the other takes over. But server mirroring is costly and inefficient. The mirrored machine—a full-fledged system, with all the accompanying costs and space requirements—does nothing but sit around waiting for its turn; it can't be used on its own. (In an ideal world, in fact, it wouldn't be used at all, because the primary server would never go down.) Server mirroring is a lot like an insurance policy: You buy a secondary server hoping you'll never have to use it, but if you never use it, the money you put into it year after year might as well be flung into the void.

Clustering is different. Each server in a cluster can operate on its own, thus ensuring that the investment it represents is put to its best use. When one machine in the cluster goes down, another takes its role—in addition to the work it's already doing. In that way, a cluster operates like a well-trained employee task force, in which members work on their own assignments and pick up an absent member's assignments until everyone is back in place. Clearly, that is a much more cost-effective solution than having staff sitting around doing nothing, kicking into action only if someone is unavailable.

### HOW CLUSTERS WORK

Clusters work primarily through mutual distrust. All the servers in the cluster keep polling each other to see if each one is working, and if something isn't right, the fail-over mechanisms leap into action. Polling isn't a simple thing. It relies on the cluster inter-

The drive controllers, which are SCSI-based and will be for the foreseeable future, provide not only the means for sharing the drive array among the cluster, but also a means for checking machine availability. If a machine determines through interconnect and LAN polling that another machine in the cluster is off-line, it will take over that machine's disk resources in order to keep them available to the network. When the disabled machine goes back online, the substitute will relinquish the appropriated disk resources to their rightful owner as soon as the no-longer "missing" machine tries to access them. All of this happens automatically, and it's all part of a fail-over.

For a fail-over to occur, all three conditions must be met: The interconnect poll must fail, then the LAN poll must fail, and then the polling machine must succeed in taking control of the missing cluster member's disk resources without their being taken back. It can all happen in less than a minute (less than 10 seconds, if the failure is complete), after which a designated backup machine takes over the failed machine's tasks. When you realize that the process entails the reconfiguration of many network resources—disk shares, printer assignments, even machine names—and that the backup server might be busy with work of its own at the

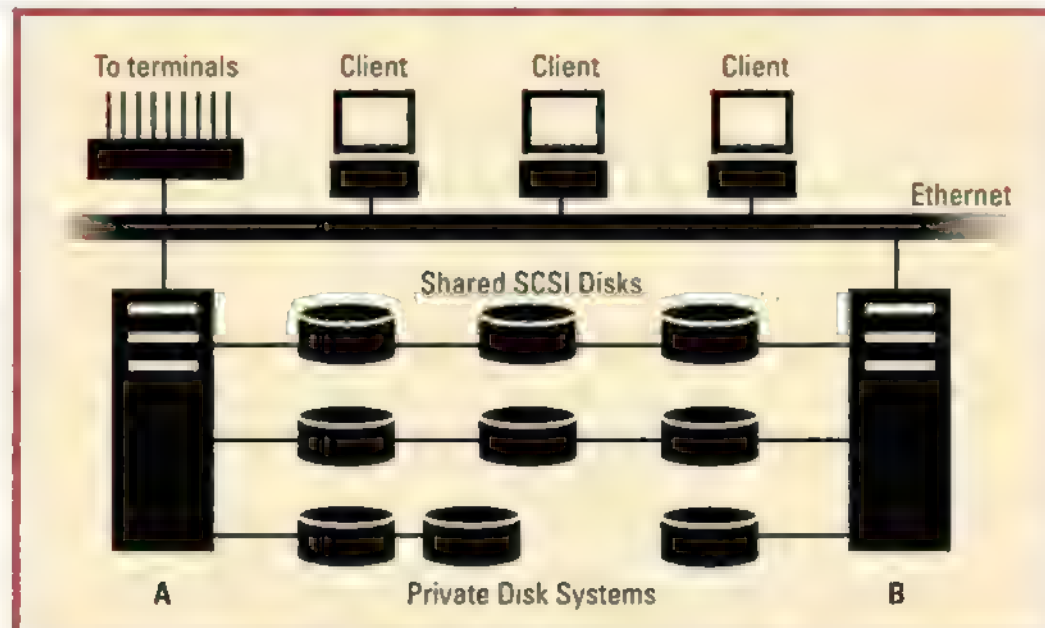
moment of fail-over, it's easy to see why the transfer of resources might take a bit longer than desired.

### CLUSTERING METHODS

Although different operating systems and hardware environments offer different methods of clustering, the two that have captured the most attention are called *shared disk* and *shared nothing*. As their names suggest, one offers clustering through the sharing of resources, particularly disks, and the other through no predetermined sharing at all. While it would seem at first glance that the shared-disk method would be superior, in fact the shared-nothing method is more

sophisticated. Both can work together in the same clustered system.

The shared-disk method is actually a sharing of hardware resources. Disks, however, take precedence because of their importance to any system. In the shared-disk method, any machine in the cluster can access any shared device. As Figure 1 illustrates, disk arrays in a shared-disk system connect directly into each computer by way of the array hardware's multiple I/O ports and a Distributed Lock Manager (DLM), which provides the necessary synchro-



**FIGURE 1:** This two-machine cluster shares the disks according to the Distributed Lock Manager's instructions. The clients have full access to both server machines, each of which performs its own duties and can take on the duties of the other if necessary.

connect system, the local area network (LAN), and the drive controllers.

The cluster interconnect device (think of it as a secondary network card) polls the other machines in the cluster to see if they're available. If a server doesn't respond, the polling machine tries to find it through the LAN, its failure or success indicating whether the problem lies with the target server or with its interconnect device, respectively. Problems are reported to the systems administrators through alerting and logging systems.



# PCTech Operating Systems

nization. Since a disk can be physically read by only one machine at a time, the DLM queues requests and determines which machine gets access at which time. In the case of Windows NT, the shared-disk method takes full advantage of the operating system's built-in fault tolerance and disk mirroring to ensure that all information is both current and protected.

In the shared-nothing method—which could stand a name change—resources are not specifically shared among machines in the cluster, but all machines have the potential to share all resources. That's its power and also its complexity. Essentially, each server in a shared-nothing system acts as the owner of a specified set of the cluster's resources. The administrator configures the clustering software so that ownerships are clear to the network, defining which machines will handle what requests for data or processes. When a request is for resources that span multiple machines, one machine acts as host and requests resources from the rest of the cluster, until the request has been resolved and the data can be returned to the client machine that placed it. The shared-nothing method, although complex, makes it possible to distribute data, applications, and all other resources across a series of clustered machines. Shared-disk systems are less scalable, not least because you can connect only so many machines to so many physical resources, such as disk arrays. Clustering software acts, in effect, as an overarching protocol for a group of servers to communicate with one another for very specific purposes.

## MICROSOFT MOVES IN

Like all technologies, clustering comes with more than its share of terminology. But for Microsoft and the companies supporting its operating systems, the most important words are *availability* and *scalability*. That's not to suggest that the clustering technologies Microsoft has adopted represent even a major portion of the world's clustering solutions (in fact, the company comes rather late to the party), but rather to say that Windows NT Server has become such a significant enterprise system that anything added to it immediately takes on importance. Microsoft is in the process of adding clustering to Windows NT 5.0 with a technology package code-named Wolfpack, whose function is to grant availability and scalability to Windows NT Server-based applications at the enterprise level.

*Availability*, also known as *system availability*, refers to the ability of the system to keep serving even when one of the component servers fails. Availability is possible with as few as two servers, but it shows its power when the cluster consists of multiple servers. Let's say,

for instance, that you have an important meeting with a customer, in which you'll use a PC as a client machine to access database records from a server. If the records reside on a single server, they will be inaccessible if that machine fails. But if the records come from a cluster, the request from the client will get passed from the failed machine to the cluster, which will fulfill the request. You and your customer will get your information, and except for a brief delay (which you might easily attribute to network congestion) neither of you will even know the clustering software has kicked in.

In the first incarnation of Wolfpack, fail-over will be possible only between two servers. But even this limited clustering solution will enhance availability in two ways:

- It will keep server functions available during maintenance and repair and let server administrators take their time to give those tasks the attention they require (rushing is often necessary in a single-server environment).
- The clustering software will attempt to determine which services and procedures have failed and get them running again. Of course, there's nothing the software can do in the event of a hardware failure or power outage, but software problems are sometimes solvable.

The ability to solve software problems is one of Wolfpack's essential ingredients. Because its technology has been designed exclusively for machines running Windows NT Server—unlike Unix solutions, which have to work across various operating-system flavors—Wolfpack can focus on Windows NT's peculiarities. If a served application crashes, it can be restarted automatically, on another server, if necessary. And administrators can initiate a fail-over manually, either to start a planned shutdown or to redistribute the server load.

In most real-world applications, resources are not static but continue to grow with an organization's needs and activities. With growth, it can become necessary to add new machines to a cluster. The ability to do this is known as *scalability*. All of the most enticing possibilities assume a cluster of several servers, not just two. Unix solutions, in fact, have long made that assumption, and for Windows NT to compete as a clustering technology, Wolfpack has to do so as well. Although Wolfpack begins with support for only two servers, it will allow for an increasing number of systems as the product evolves. Clustering up to 16 servers is intended for the foreseeable future, and more after that. Given what's happening with intranets and extranets, and the consequent need for more and more networked resources, that direction is clearly the only one Microsoft can take.

One approach to scalability that Wolfpack avoids is the symmetric multiprocessor (SMP)

model, which lets systems—processors, in particular—work with a shared I/O architecture and memory structure. In other words, you have several different computers, but they all depend on a systemwide memory and I/O environment. The advantage of the model is that adding new processors is less difficult when only one instance of the operating system is running than when each processor runs its own OS. SMP systems are relatively easy to manage. But the disadvantage is that bottlenecks occur with both memory and I/O, as more and more processors get added.

Wolfpack provides the means to add entire systems to the cluster, each running its own version of Windows NT Server on its own processor (or multiprocessor board), with its own memory and I/O subsystems. Although that avoids bottlenecks, it creates a different problem: Services must be available to other machines than the one on which their operating system is running. In other words, they have to be made "cluster-aware." They have to understand how to restart themselves if they go down, or, if that's not possible, to relinquish control to another machine. Or, if a service is configured to run on two machines in order to share the load, each machine must be able to take the entire load if the other goes off-line. And, of course, applications must know how to make use of a clustered network.

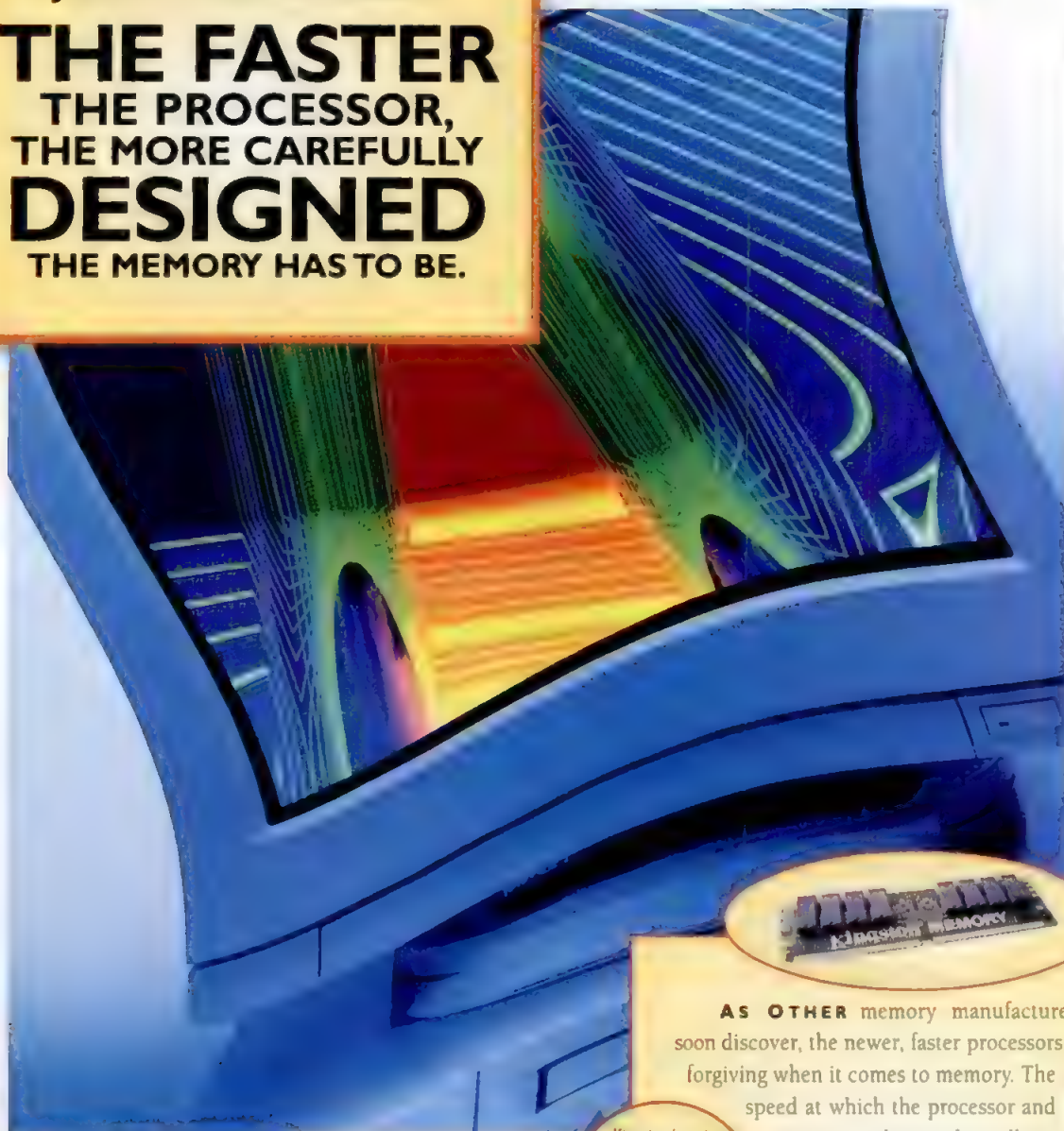
As you consider clustering for your organization, it's important to keep in mind that Wolfpack alone isn't likely to solve everything. Several companies have committed themselves to developing third-party solutions that fit on top of Wolfpack and make the most of the technologies that Wolfpack introduces. For one example, take a look at the ServerNet and Non-Stop Software offerings from Tandem Computers ([www.tandem.com](http://www.tandem.com)). Other companies with Windows NT-based clustering products include Digital Equipment Corp., NCR Corp., and Oracle Corp.—the last of which offers Fail Safe for Windows NT, for managing database fail-over, and Parallel Server for Windows NT Clusters, which improves on Wolfpack's basic clustering management software.

The adoption of clustering in Windows NT will move the OS closer to becoming an enterprise replacement for Unix. But it remains to be seen how many organizations will bite. Whatever its capabilities, Windows NT is still seen by many IT professionals as a PC operating system with PC limitations. There's certainly some truth in that, and it may take a long time for those attitudes to change. **PC**

*Neil Randall is a frequent contributor to PC Magazine and author of The Soul of the Internet (ITP).*



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# corporation. hood pizzeria?

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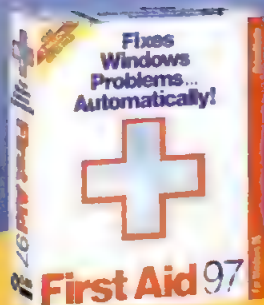
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## Distributed Programming With CORBA and IIOP

*Building applications with objects that can interoperate across different languages, OSs, and platforms.*

By William R. Stanek

**T**he explosive growth of the Internet and the Web has opened the door to technologies that are changing the way we use computers forever. Some of the biggest changes are in object-oriented technology, where visionaries are giving new meaning to distributed computing. Instead of the traditional client/server network, the new era of distributed computing brings with it enterprise systems whose objects are distributed across multiple computers that can all communicate, regardless of operating system, platform, or programming language. Even more amazing is that these distributed objects can be components of a single application or of the dozens of applications that form the enterprise system.

Technologies that enable distributed computing across heterogeneous systems are the Common Object Request Broker Architecture (CORBA) and the Internet Inter-ORB Protocol (IIOP). CORBA specifies the complete architecture necessary for communication between distributed objects. The specification includes IIOP and a host of other technologies. IIOP is the most important piece of CORBA, because it focuses on interoperability of distributed objects in heterogeneous environments. Together, CORBA and IIOP define the holy grail of middleware that could cause developers around the world to rethink how they create applications in networked environments.

CORBA and IIOP aren't the only distributed-computing solutions. Microsoft has a competing architecture called the Distributed Computing Object Model (DCOM), basically an Object Request Broker (ORB) that is part of Windows NT 4.0 and will be part of the next release of Windows.

### OMG AND DISTRIBUTED COMPUTING

CORBA is the brainchild of the Object Management Group (OMG), a consortium with a membership of more than 700 companies from many different industries. The or-

ganization's goal is to provide a common framework for application development using object-oriented techniques. Instead of applications, OMG produces specifications that make distributed-object computing possible, and it is this focus on ideas over code that has made the group such a success.

OMG's biggest success story is CORBA, first implemented in 1991. By describing a common architecture for communication between distributed objects, CORBA makes it possible for an application's components to communicate, regardless of their locations on a network. Further, because CORBA defines a common interface between objects, the operating system and the programming language of the object don't matter. As long as an object is CORBA-compliant, it can communicate with other distributed objects.

Introduced as part of the CORBA 2.0 specification in December 1994, IIOP is another success story for OMG. Before IIOP, the CORBA

enterprise system, your Windows NT server could store core file-services objects used by the application. These objects could be programmed in C++. Your mainframe could store the application's primary back-end functions—perhaps using objects programmed in COBOL. Each of your desktop systems running Windows 95 could store the application's front-end interfaces, using objects created in Visual Basic. And all of the objects could communicate by brokering requests with CORBA.

Netscape Communications Corp. and Sun Microsystems both use CORBA and IIOP in their next-generation products. Sun uses CORBA and IIOP to implement heterogeneous remote procedure calls in Java 1.1, and without those technologies, the Java Platform for enterprise networks wouldn't be possible. Further, the Enterprise JavaBeans API will use CORBA and IIOP to allow scalable business applications with reusable server components.

It's possible to make remote procedure calls to Java using DCOM. The necessary hooks are available with Visual J++. But DCOM is available only on Windows NT 4.0 and Windows 95 (through an Internet Explorer Extension), which means you cannot use DCOM to implement communications to other operating systems. Microsoft has announced that DCOM will be ported to other platforms in the future.

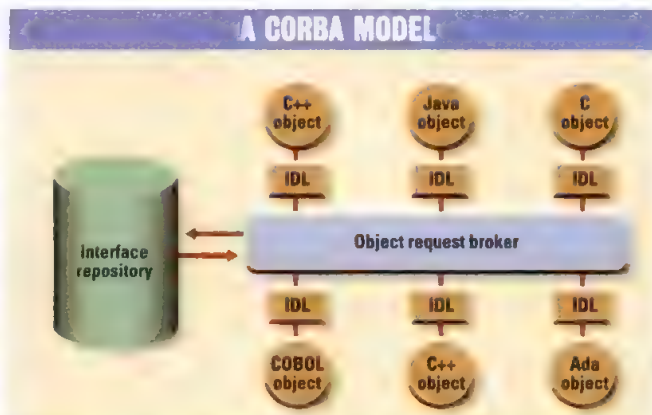
IIOP lets Netscape's Open Network

Environment (ONE) communicate with enterprise-wide systems. IIOP also lets programmers connect Java, JavaScript, and C or C++ code to enterprise-wide systems. In Netscape Navigator, IIOP is the protocol within LiveConnect that lets applets, plug-ins, and scripts communicate with each other. ("Energizing Your Web Pages," in our issue of September 9, 1997, has more on LiveConnect.)

### A LOOK AT CORBA

The heart of CORBA is the Object Request Broker (ORB). It is the object bus. The job of the ORB is to act as a middleman, allowing objects to make requests of each other. Although the ORB operates in a client/server environment, objects the ORB works with can function as either clients or servers, depending on the circumstances. If an object is receiving and processing a request, then it is acting as a server. If the object is making a request, then it is acting as a client.

Brokering requests and returning results is a full-time job for the ORB, involving intercepting



**FIGURE 1:** A basic model of CORBA, showing how the Object Request Broker (ORB) mediates among objects using an interface repository.

specification defined interaction only for distributed objects created by the same vendor; the objects had to be designed for a specific implementation. Using IIOP, the second CORBA specification became the definitive solution for object interoperability that wasn't tied to a specific platform or implementation.

Employing CORBA, you can create an enterprise-wide system with objects distributed throughout the network. Within the



each request from one object to another, locating the object that's supposed to handle the request, invoking the appropriate method in the receiving object, passing parameters if necessary, and returning the result to the object that made the request. Because the ORB handles requests transparently, it doesn't matter whether the request is from a local or a remote object.

The ORB handles these requests regardless of programming language, operating system, or platform. The mechanism that allows ORBs to handle requests transparently is the Interface Definition Language (IDL), which is used to declare the boundaries and interfaces of an object. Much like an independent arbitrator, the IDL is neutral and independent of the object and the ORB, yet it binds providers of distributed-object services to their clients. Anyone familiar with DCOM may know that DCOM uses an IDL. But the DCOM IDL is not CORBA-compliant and does not behave in the same way as the CORBA IDL. CORBA supports multiple inheritance, and its IDL uses inheritance to encapsulate objects. That makes reuse of code very easy. DCOM does not support multiple inheritance, so you must contain and aggregate your interfaces before presenting them to a client.

The beauty of IDL is that you can concisely define APIs yet still have the freedom to define the IDL methods in any programming language that provides CORBA bindings. Such languages include Ada, COBOL, C, C++, Smalltalk, and Java. Vendor-specific mappings to CORBA are also available for Visual Basic and FORTRAN.

As anyone who has done object-oriented programming knows, you need to know a receiving object's interface before you can make a request, and you design your objects so that they know the interfaces of the objects they interact with. But with distributed computing between heterogeneous objects, you'll run into lots of problems if you try that approach.

To make IDL truly independent, CORBA uses an interface repository, the purpose of which is to store the method signatures of objects so that the signatures can be dynamically retrieved and updated at runtime. In this way, all objects in the enterprise system can learn about other objects' interfaces, the methods the interfaces support, and the parameters the interfaces require. (DCOM also supports a registry and lookup services that let clients learn about the interfaces a component supports as well as the parameters needed to invoke a particular method.)

When you bring together the ORB, the IDL, and the interface repository, you have a basic model of CORBA (see Figure 1). Although the model doesn't include all the pieces of the

architecture, you can get an idea of how heterogeneous objects interact using CORBA.

## FITTING THE PIECES TOGETHER

As a technology that provides the framework for interaction between dissimilar objects, CORBA succeeds admirably, yet that is only a piece of a greater picture called the Object Management Architecture (OMA), the primary components of which are:

- **CORBA ORB**—handles requests among objects;
- **CORBA Services**—defines system-level services that help manage and maintain objects;
- **CORBA Facilities**—defines facilities and interfaces at the application level;
- **application objects**—the objects themselves.

As we've discussed, the Object Request Broker handles requests between objects. But how do the other pieces of the puzzle fit together? Let's take a look at CORBA's services, facilities, and objects.

## CORBA OBJECT SERVICES

Helping you manage and maintain objects through their life cycles is what the services are all about. You'll use the interfaces they provide to create objects, handle object security, determine the location of objects, and perform class-level management of objects. Because they are system-level rather than application-level services, you can implement them across the enterprise, saving you time and making it easier to create consistency throughout your enterprise system.

There are 16 object services, including:

|                     |               |
|---------------------|---------------|
| Collection          | Properties    |
| Concurrency control | Query         |
| Event notification  | Relationships |
| Externalization     | Security      |
| Licensing           | Startup       |
| Life cycle          | Time          |
| Naming              | Trader        |
| Persistence         | Transactions  |

The many broad areas that the CORBA object services cover let developers focus their efforts on their objects, without having to worry about system-level services. You can develop a class for your object and then use the object services to add the functionality they provide. You handle this with subclassing and multiple inheritance. For example, if you create a `Widget` class, you can then create a subclass called `aWidget` that is persistent simply by inheriting from the Persistence service. You could also handle event notification, security, and queries by inheriting from the appropriate services.

CORBA extends the power of subclassing

and multiple inheritance with *metaclasses*. A metaclass is a class of objects that can be created at runtime. Using metaclasses, you can dynamically add services to CORBA objects, allowing you to customize objects on demand.

## CORBA OBJECT FACILITIES

The object facilities define frameworks that provide interfaces and other services. These frameworks are divided into broad categories that include application interfaces, domain interfaces, and networking facilities.

Application interfaces consist of non-standardized facilities specific to individual applications, such as a reservation system or inventory management system. The domain interfaces consist of facilities for end users in specific *application domains*. (Here a *domain* refers to a specific vertical market or industry.)

Whereas domain interfaces focus on specific markets, Internet facilities are the application-level functions and interfaces that reach a broad market. These facilities include common user-oriented tasks within applications, such as printing or saving a file, yet also reach into common networked tasks, such as using e-mail and networking facilities.

## APPLICATION OBJECTS

The actual objects that form the core of a CORBA-compliant application are called *business objects*. A business object is a way of describing concepts that are independent of an application, such as a customer, order, or payment. You will use a collection of business objects to create an application.

Unlike *system-level objects*, which handle tasks such as persistence, business objects handle real-world business processes. Although a typical business object may handle only a single task (such as working with reservations, customers, or inventory), collections of business objects can be used to handle an entire business process, such as booking and managing reservations for an airline. Because business objects come with ready-to-use functionality, a developer can stitch them together to create a custom application.

In order to manage the complexity of an application with distributed business objects, the business objects know only what services other objects provide, not how those services are actually implemented. Business objects hide the complexities of back-end processing by focusing on interfaces rather than on implementation.

## DISTRIBUTED PROGRAMMING

A *component* is a collection of business objects that handles processing, encapsulates data, and provides necessary user interfaces.



# PCTech Power Programming

Objects within a component use the ORB to interoperate. The ORB also lets the objects exchange information about each other, which allows objects to learn about each other at runtime. In this way, the component has everything that you need to display a representation of an object on the screen and to interact with it. A typical business component could be used to display the seating assignment for an 11:00 flight to Los Angeles. Another component could be used for booking a reservation on the flight.

Components can be enhanced by using system-level services. You can use the Persistence service to maintain the state of objects within a component. You could also use the Concurrency and Transaction control services to maintain the integrity of objects within the component. Because these services are built into CORBA, you can use them to create smart components without having to code from scratch. Although DCOM does have a component registry and lookup service, there is no way to maintain the state of DCOM components between connections. This shortcoming gives CORBA an edge over DCOM.

At the application level, the application frameworks define the ways independent components work together, which sets the

boundaries of the component infrastructure. The clearly defined boundaries let the components work together as a suite, giving the application a sense of cohesion. It is that unity that lets applications with objects distributed across heterogeneous environments come together seamlessly. Seamless integration means that users see an application as a unified whole rather than a complex web of unrelated objects.

You can extend the component infrastructure of a single application to the component infrastructure of multiple applications. In this way, you use CORBA to enable communications for the many different applications within an enterprise system. For applications that are not CORBA-compliant, such as legacy applications, you can create wrappers that make them appear to be other CORBA objects. A wrapper accomplishes that by providing the interface necessary for accessing specific functions within a legacy application.

Once you've used CORBA to integrate legacy applications with client and server processes, you have all the pieces of the multi-tier client/server model. One tier has visual objects, such as the interface, that reside on the clients. Another tier is for server objects that provide business functions. Legacy appli-

cations, such as your DBMS on a mainframe, are on a different tier.

## SUMMARY

With its backing consortium of more than 700 companies, CORBA is anything but the latest craze to hit the market. CORBA goes way beyond the traditional three-tier client/server model, because it is completely scalable and extremely flexible. Using CORBA, you can easily scale up from a network of three computers to an Internet-size network. CORBA provides the framework that lets you connect objects programmed in different languages, and you can do so regardless of the platform or operating system for which the objects were designed, as long as CORBA mappings are available. Because CORBA can operate across heterogeneous platforms, it has an advantage over DCOM at the present time. But with the Microsoft powerhouse behind it, DCOM is sure to be a force to reckon with in the coming years. **PC**

*William R. Stanek is executive director of Global Internet Solutions and author of several books, including Peter Norton's Guide to Java Programming and Netscape ONE Developer's Guide. He can be contacted at [director@tvpress.com](mailto:director@tvpress.com).*

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## Pushing the Envelope with Push Technology

*Get ready for a new way of delivering information and programs to your desktop.*

By William R. Stanek

**D**o you love to find the newspaper on your doorstep in the morning? Are you a news junkie? Do you read sports scores with the enthusiasm of a stock-market watcher? Are you a stock-market watcher? If you answered yes to any of these questions, you may love push technology. After all, the notion of personalized news and information delivered to your doorstep is what push technology is all about.

Ever since push appeared in the public eye, it has been the hottest buzzword in the industry. With millions of people watching push, it should be no surprise that push is fueling a period of frenzied growth in networking technologies. At times it seems that every technology company under the sun is scrambling to support push, promote push, or otherwise work push into upcoming products. To help you make sense of the sea of current and upcoming offerings, let's take a look at where push has been and where it is going.

### EXPLORING PUSH

Sunday is newspaper day. As weekdays roll by, you may not have time to read the paper each morning and the papers start to pile up. But when the weekend rolls around, you cast those old newspapers aside and settle in with those wonderfully thick weekend editions that recap what you missed during the week.

Think of that newspaper delivered to your doorstep as a form of push technology. When you want to read the paper, you open your door and grab the paper and you are on your way. When you don't read the papers, they pile up and you probably throw them away a few days later. Although the information arrives in the form of a newspaper, it is being pushed at you all the same, and you make the conscious decision to read or not to read it.

Information delivery with push technology follows a similar process, except that your PC serves as your doorstep. When your PC is online, the newspaper delivery boy knows that you are ready for the next delivery, and the in-

formation is delivered automatically.

Automated content delivery to your PC is what most people consider to be push and actually is push. But more often than not what's thought of as push is really *pull*, with your computer doing the checking for new information. Anytime your PC reaches out and looks for new information, you are actually using a form of pull.

When new content arrives on your desktop, the information can be displayed in a variety of ways. Most *push client* software displays the information in a small window at the bottom of your screen, called a news ticker—as with IBM NewsTicker and My Yahoo! News Ticker—or as a screen saver that displays information when your PC is idle, as

worry about getting flooded with information of no interest to you. But as with those papers that tend to pile up on your doorstep, you may find that too much information is flowing to your desktop and that you are not getting any work done because you are spending too much time catching up with the news. Fortunately, most push client software can be set to discard old, unread content packets, and best of all, you don't have to bundle them with a string and put them out by the sidewalk.

### PUSH CLIENTS

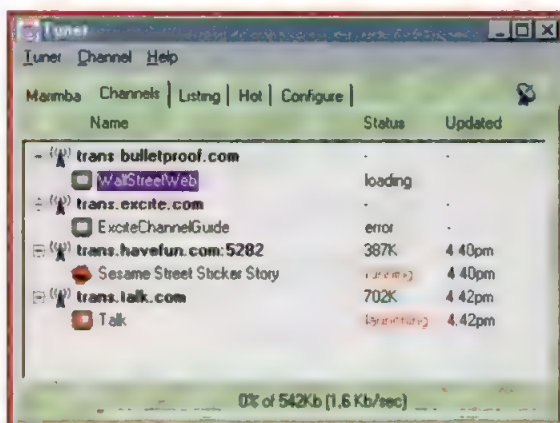
The software receiving and displaying information on your PC is a push client. Like other client software, such as your Web browser, push clients are only one side of a client/server process. On the other side of this process, you will find *push servers*, which are responsible for sending channels of information to clients.

The various channels usually contain different types of content. One channel may be for sports summaries from *Sports Illustrated*. Another channel may be for news headlines from CNN. By subscribing to the channels that you want to see, you can tune the content to your personal preferences. Keep in mind that the availability of various channels depends on your client software. Three of the most popular push clients are AirMedia Live, Marimba Castanet, and PointCast.

PointCast has positioned itself as the Internet news network. Channels of information that you can subscribe to cover headline news, stocks, sports, weather and more. Content comes from major players such as CNN, *People*, Reuters, and *Time*. You can get Version 2.0 of PointCast free of charge by visiting PointCast's Web site ([www.pointcast.com](http://www.pointcast.com)).

Whereas most other push clients depend on a connection to the Internet, AirMedia Live uses wireless technology to deliver broadcast content by radio. The simplicity and low cost of wireless technology have attracted lots of attention. AirMedia focuses mainly on news, sports, stocks, and weather but also provides other types of information. Channels you can subscribe to come from the likes of CBS SportsLine, CNN, MovieLink, Reuters, and The Weather Channel. Although you must purchase AirMedia's wireless receiver to connect to the service, you can view a demo at AirMedia's Web site ([www.airmedia.com](http://www.airmedia.com)).

Until recently, most push clients supported only channels paid for by major content



**FIGURE 1:** Marimba's Castanet Tuner is a Java-based system that lets an individual set up a transmitter—a server product—to send information channels to subscribers.

with AfterDark Online and PointCast. Other push client software displays the information in an application window that you can check periodically. To streamline the push process as much as possible, the information coming to your desktop is usually a summary of a larger document that you can access by requesting additional details.

Instead of delivering all of the sections such as finance and sports, your virtual newspaper sends you only channels of information to which you've subscribed. Because each of these channels can be personalized to meet your information needs, you do not need to





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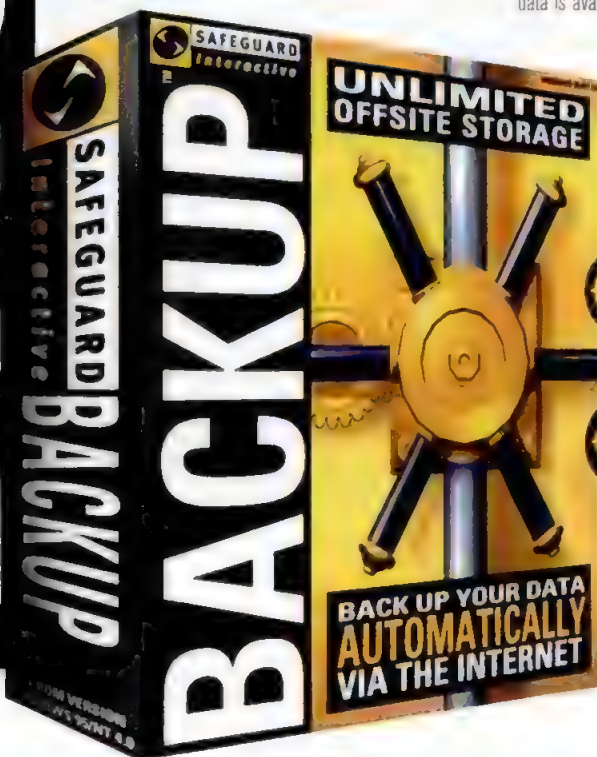
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providers, making push a toy that only big-league content providers could afford and effectively locking out small content providers like you and me. Fortunately, push technology has graduated to the next level of products that make it possible for anyone, whether they have big bucks or not, to create and broadcast content.

A shining example of the move to let small content providers create their own channels is Marimba's Castanet Tuner. Castanet Tuner is a Java-based system that lets individuals set up a transmitter—a server product—to send information channels to subscribers. Content delivered to the various channels of the Castanet tuner can be in the form of applications or Web pages. You can obtain demo versions of the Castanet tuner and transmitter by visiting Marimba's Web site ([www.marimba.com](http://www.marimba.com)).

## PUSH SERVERS

Delivering content to your desktop is the job of push servers. The move to let individuals publish content has spurred rapid changes and growth in push server technology, driving push technology companies to rethink their strategies. But that does not mean push technology companies have abandoned their proprietary and restrictive formats.

Although most push servers are designed to be used on an internal network, there are a few push servers you can use on your public Web site as well as your intranet. (For more information, see our roundup of push servers, "The Intranet Channel," in the June 10, 1997, issue.) The biggest name in intranet and Internet content-delivery solutions is Marimba. Using Marimba's Castanet Transmitter, you can set up your own channels. The fact that you can use Castanet Transmitter to deliver application upgrades is the strongest selling point for intranet use of Castanet. The Castanet Transmitter license fees are based on the number of clients that access the server—about \$1,000 for 100 client accesses per hour.

Another big name in intranet and Internet content-delivery solutions is BackWeb Technologies ([www.backweb.com](http://www.backweb.com)). With BackWeb, you can set the server software to receive any of the dozens of public channels from content providers such as PC Quote, *The Wall Street Journal*, and Yahoo! These channels are cached and relayed to clients, reducing the drag on the network. The biggest selling point for the BackWeb server is that it can deliver multimedia, bitmaps, and executables as well as standard text and HTML content. You can also create your own channels to deliver content. Although the client software is free, you must purchase a license to use the server software beyond the trial pe-

riod. The list price for BackWeb Channel Server 2.0 is about \$10,500, with additional server fees based on the number of channels that you create.

PointCast I-Server takes a completely different approach by using what is largely a proxy server designed for intranets. Rather than replacing the proprietary channels, I-Server works to cache the existing channels and extend the lineup to make room for private channels. By caching channels of data sent to the internal network, I-Server reduces the bandwidth drain on the company's Internet connection. By allowing you to create your own channels, it gives you the ability to deliver content specifically tailored to the

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The fact that you can use  
Castanet Transmitter to  
deliver application  
upgrades is the strongest  
selling point for intranet  
use of Castanet.

---

needs of your corporate customers.

Because PointCast channels contain advertising, much of the cost of running the network is absorbed by advertisers. For this reason, PointCast charges a flat fee for the server license based on the number of CPUs in the server—about \$995 per server CPU. Although PointCast I-Server can deliver only HTML content, the server makes up for this through its integration with Lotus Domino, which lets you link push content directly to your business applications and databases.

## NEXT STOP: PUSH DESKTOPS

Microsoft Internet Explorer 4.0 and Netscape Netcaster are bringing push technology to the desktop in a big way. With these two products, the latest advances in push technology will be cleanly integrated into your Web browser and your desktop. Instead of having to go through several different proprietary clients to get your hands on all the information you are looking for, you can access channels from several different push services right in Internet Explorer 4.0 or Netcaster.

With Internet Explorer 4.0, you can access BackWeb channels and PointCast channels without separate clients. You can also access any channels that use Microsoft's Channel Definition Format (CDF), a proposed stan-

dard for push content that can be delivered using existing HTTP server technology. CDF lets a publisher create a channel that incorporates HTML, ActiveX, and Java.

Beyond direct support for clients and CDF, Internet Explorer 4.0 also features support for Web site subscriptions. The subscription method is an ingenious way to keep people apprised of changes to their favorite Web sites. Whenever a Web site changes, the subscribers are notified. If you have configured your browser to make automated content updates, the browser will retrieve the new information so that you can view it off-line at your leisure. Otherwise, you will simply receive an update notice via e-mail or see an update icon next to the site listing in the Favorites menu.

Netscape Netcaster is an add-on for Netscape Communicator. When you install Netcaster, the application is completely integrated into the Communicator application suite. Currently, the only proprietary push product Netcaster supports directly is Marimba Castanet. But other push technologies developed by Netscape are built into Netcaster.

The showcase push technology within Netcaster uses existing Web technologies such as Java, JavaScript, and HTML to create Web sites that can deliver customized content to users. Web sites that use Netscape's push technology are called LiveSites. The main ingredient added to a LiveSite missing from a traditional site is the markup needed to send content updates to users.

The main viewing area in Netcaster is referred to as a *home port*. You can configure your home port to receive update notices pertaining to your favorite Web sites. Your home port also has an area for displaying real-time information, such as sports scores and stock quotes. As a publisher, you broadcast this real-time information to subscribers in the form of *pagelets*, which are simply small Web pages that can use HTML, Java, and JavaScript.

## STANDARDIZING PUSH

Dealing with the profusion of push technologies is worse than trying to customize your Web pages for each of the major browsers, especially in view of the fact that each of the dozens of product offerings uses its own proprietary format. As an administrator, you may have to deal with several different push clients and servers to satisfy the needs of your corporate clients. As someone who wants to create and produce a push channel, you want your information to reach the widest audience possible, which may mean setting up several push servers and developing content in several different formats.



# BOOKMARKS



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## PCTech

One proposed solution for the push technology deluge is Microsoft's Channel Definition Format, which gives content developers a way to create channels and distribute information using a publicly supported standard. Because CDF defines push content and channels using standard ASCII text files, push content can be delivered using existing Web server software and technologies, meaning there is no additional server software to install.

The actual markup within a CDF file is based on Extensible Markup Language (XML), which is akin to HTML and SGML. Because of this close relationship to HTML, CDF markup has a very familiar look and feel. Web publishers will need to learn fewer than 20 new markup tags to master content delivery with CDF. These tags let you define how the content will be delivered, when it will be delivered, and what it will look like.

CDF lets you direct the push content to Internet Explorer 4.0's channel viewing pane, a component on the desktop or the IE4 screen saver. To control access to the content, you can add user authentication with a log-on prompt that asks for a user name and password. To keep track of content delivery and accesses, you can set up the channel to log user actions automatically.

CDF is still under development, but the format already has some major supporters, including BackWeb and PointCast. You can learn more about CDF at [www.microsoft.com/standards/cdf-f.htm](http://www.microsoft.com/standards/cdf-f.htm).

Netscape also has submitted a proposal for a push technology standard to the World Wide Web Consortium (W3C), called the Meta Content File format.

### SUMMING IT ALL UP

Despite the possibility of information overload, push is a technology that's steadily evolving into an information medium for the masses. Although it wasn't so long ago that products were proprietary and content couldn't be developed by individuals, many options now exist for information providers and users alike. As you set out to make sense of the wealth of offerings, keep in mind that push is moving to the desktop, where before long we'll be able to receive content from multiple sources using a single client product.

*William R. Stanek is the executive director of Global Internet Solutions and author of several books, including Web Publishing Unleashed, FrontPage 97 Unleashed, and Netscape ONE Developer's Guide. His eighth computer book, Increase Your Web Traffic in a Weekend, was published in July. William can be contacted at [director@tvpress.com](mailto:director@tvpress.com).*



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# User-to-User

BY NEIL J. RUBENKING

## Open Files with the Application of Your Choice

While using Explorer I discovered that if you select a file and then press Shift while right-clicking on it, you get an extra "Open with" selection on the pop-up menu. This lets you select a new program to open the file. You can easily change how you open a file that has already been registered with another program. It's a lot easier than going into View | Options | File Types and looking through all of the file extensions.

PAK-TSUN WONG  
Richmond Hill, Ontario, Canada

**PC MAGAZINE:** Most of the time it seems quite convenient that right-clicking on a data file in Explorer (Windows 95 or Windows NT 4.0) brings up a context menu specific to that file type, and that double-clicking activates the default menu item. In most cases the default menu choice loads the data file into the application that's associated with its extension. But some file types can be opened by more than one application. For example, you might want to load a .DOC file into WordPad rather than launch the much larger Word for Windows. You could launch WordPad separately and then navigate to the file in the File Open dialog, but using Shift-**<right click>** to get the "Open with" menu item is much quicker.

In other cases, one extension may have multiple meanings. For example, the .SCR extension defines a screen saver by default, and its right-click menu includes the options Test, Configure, and Install, but some programs use the .SCR extension for command scripts. Hold the Shift key and right-click on the file and you can open it with any application on your system.

## Finding the Win 95 Logo Bitmap On a Compressed Drive

I followed the instructions for changing the Windows 95 start-up logo screen (Ask Our Advisors, February 18, 1997), with absolutely no result. It drove me nuts when I changed LOGO.SYS with Paint and the old logo kept coming up. I looked all over C: and could not find another file that looked anything like LOGO.SYS. It finally dawned on me that there might be a copy on drive H:, the host drive for my compressed C: drive. I modified that one. Lo and behold, it worked.

AL TAYLOR  
Winnipeg, Canada

**PC MAGAZINE:** The contents of a drive compressed by DriveSpace reside in what's called a compressed volume file, and the drive that holds the compressed volume file is known as the host. When you compress an entire drive, DriveSpace gives the original drive letter to the compressed drive and assigns a new letter to the host. In this case, Mr. Taylor had compressed drive C:, and DriveSpace assigned the letter H: to the original host drive.

This situation can be confusing when the drive in question is the system's boot drive, as the working copies of essential files such as CONFIG.SYS and MSDOS.SYS reside on the host. As it turns out, the same is true of LOGO.SYS. It appears that the logo is displayed before the mapping of the host drive to its new letter has taken place. Just to add to your confusion, DriveSpace can optionally hide the host drive. When the host is hidden, you can still switch to it in a DOS box or enter a pathname on the host drive, but it won't show up in Explorer's display.

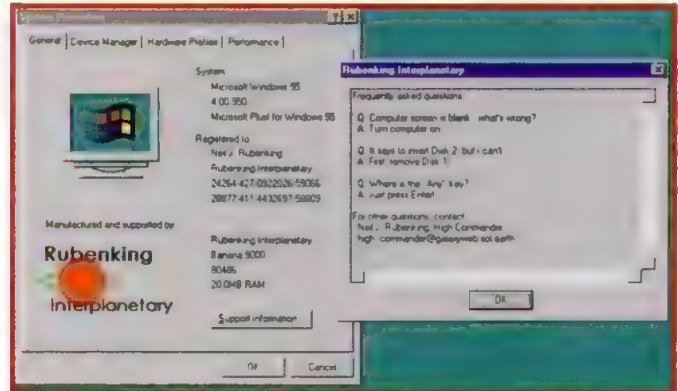
Other readers have written to tell me that they have run into a different problem when attempting to change the Windows 95 start-up logo. They've created a LOGO.SYS file in the correct location, but it doesn't get displayed. When Windows 95 starts, there's no logo at all, neither the default logo nor the new one. This occurs when the LOGO.SYS file doesn't precisely match the required format. A Windows 95 start-up logo bitmap must be precisely 320 pixels wide by 400 pixels high, and 256 colors. Fortunately, there's now an easy way to create logo bitmaps with the proper format—the PC Magazine utility LogoMania (which appeared in the issue of March 25, 1997). LogoMania will tile or chop existing bitmaps to the correct sizes, and it can even add animation using whatever colors you choose.

## Personalize Your System

Many systems include an OEM logo and support information that you can view by opening the Windows 95 Control Panel and launching the System applet. If you like, you can add a logo and support information to your own sys-

tem or change what is already there.

The logo is stored in the Windows system directory (normally c:\windows\system) in a file called Oemlogo.bmp. You can create a different bitmap with a maximum size of 180 by 114 pixels; any color depth (4-bit, 8-bit, even 24-bit) seems to work fine. Save the bitmap to your Windows system directory under the name Oemlogo.bmp. Next, create a file named OEMINFO.INI in the same directory. The for-



**FIGURE 1:** By placing two files in the Windows 95 system directory, you can add a logo and support information to the System Properties dialog. You can personalize your machine with any bitmap or text.

mat of this file is simple. The first section specifies general information, which is displayed to the right of the logo. For example:

```
[general]
Manufacturer=Stefan K. S. Tucker
Model=Perpetual Motion Software
```

The last section specifies what is displayed in the dialog box when the user clicks the Support Information button:

```
[Support Information]
Line1="-----"
Line2=" Stefan K. S. Tucker"
Line3=" President"
Line4=" Perpetual Motion Software"
Line5="
Line6=" stefan.tucker@myisp.com"
Line7=" http://www.mywebsite.com"
Line8="-----"
```

Note that sequential line numbers must be used in this section. Once you've created these two files, the next time you open the Control Panel's System applet, you'll see your own bitmap and the information you've specified.

STEFAN TUCKER  
via the Internet





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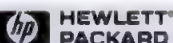
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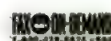
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| Ascend J10, J30, J50, J60, J80               |                  |       |                            |
| 8MB                                          | <b>\$84.46</b>   | 80811 | 10MB <b>\$129.47</b> 80809 |
| 32MB                                         | <b>\$246.80</b>  | 80810 |                            |
| COMPAQ                                       |                  |       |                            |
| Armada 1180, 4180, 4180                      |                  |       |                            |
| 8MB                                          | <b>\$87.55</b>   | 71879 | 16MB <b>\$119.51</b> 71880 |
| Armada 4110 series, 4120 series, 4130 series |                  |       |                            |
| 8MB                                          | <b>\$84.46</b>   | 74915 | 16MB <b>\$147.42</b> 74917 |
| 32MB                                         | <b>\$298.74</b>  | 74916 |                            |
| L70 Elite 5000 series                        |                  |       |                            |
| 8MB                                          | <b>\$85.16</b>   | 62485 | 16MB <b>\$147.40</b> 62486 |
| 32MB                                         | <b>\$287.51</b>  | 62487 | 64MB <b>\$344.41</b> 62488 |
| ProLiant 3800                                |                  |       |                            |
| 32MB                                         | <b>\$137.41</b>  | 79833 | 64MB <b>\$287.05</b> 79834 |
| 128MB                                        | <b>\$1339.41</b> | 79835 |                            |

| IBM                                                                      |                 |       |                            |
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| ThinkPad 365E, 365ED                                                     |                 |       |                            |
| 16MB                                                                     | <b>\$159.71</b> | 63579 |                            |
| ThinkPad 365, X, XD series, 560, 760 E, ED, EL, ELD                      |                 |       |                            |
| 8MB                                                                      | <b>\$85.12</b>  | 69580 | 16MB <b>\$128.00</b> 69704 |
| 32MB                                                                     | <b>\$284.49</b> | 71913 |                            |
| ThinkPad 340, 340C, C3, 385, 385C, C5, P, 765, C5, C5, C5, C5, C5        |                 |       |                            |
| 4MB                                                                      | <b>\$85.90</b>  | 42715 | 8MB <b>\$85.04</b> 42716   |
| 16MB                                                                     | <b>\$154.12</b> | 42717 |                            |
| ThinkPad 730, 730C series, P                                             |                 |       |                            |
| 8MB                                                                      | <b>\$154.00</b> | 35181 | 16MB <b>\$198.92</b> 35182 |
| 32MB                                                                     | <b>\$257.00</b> | 43310 |                            |
| ThinkPad 760, E, ED, EL, ELD, XD, LX, 560, 365D, 365D, 765D, L, LD, 565E |                 |       |                            |
| 8MB                                                                      | <b>\$85.12</b>  | 69580 | 16MB <b>\$128.00</b> 69704 |
| 32MB                                                                     | <b>\$284.49</b> | 71913 |                            |
| PC 3000L                                                                 |                 |       |                            |
| 8MB                                                                      | <b>\$91.30</b>  | 60296 | 16MB <b>\$148.70</b> 60297 |
| 32MB                                                                     | <b>\$309.44</b> | 60298 |                            |
| NEC                                                                      |                 |       |                            |
| Versa 6000, 6000 series, 6000 series                                     |                 |       |                            |
| 8MB                                                                      | <b>\$85.94</b>  | 71586 | 16MB <b>\$148.44</b> 71583 |
| 32MB                                                                     | <b>\$274.84</b> | 71584 |                            |
| Versa 2000 series                                                        |                 |       |                            |
| 8MB                                                                      | <b>\$85.10</b>  | 44184 | 16MB <b>\$127.39</b> 44186 |
| Versa 3400, CD, 2400, CD, 2400CD, 2400CD                                 |                 |       |                            |
| 8MB                                                                      | <b>\$85.01</b>  | 76394 | 16MB <b>\$126.05</b> 76396 |
| Versa 2600                                                               |                 |       |                            |
| 8MB                                                                      | <b>\$85.00</b>  | 65753 | 16MB <b>\$126.14</b> 65754 |
| 32MB                                                                     | <b>\$287.00</b> | 65755 | 64MB <b>\$319.55</b> 65756 |
| Versa 4000 series, E, V, M, P                                            |                 |       |                            |
| 4MB                                                                      | <b>\$81.33</b>  | 30555 | 8MB <b>\$87.82</b> 30557   |
| 12MB                                                                     | <b>\$134.82</b> | 43231 | 16MB <b>\$145.00</b> 31342 |
| 20MB                                                                     | <b>\$180.30</b> | 43040 | 32MB <b>\$289.74</b> 43041 |
| Versa 6200/60, NT                                                        |                 |       |                            |
| 16MB                                                                     | <b>\$159.49</b> | 85186 | 32MB <b>\$274.84</b> 85182 |

| Acer                                                                        |                 |       |                            |
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| TravelMate 5000 series, 5000                                                |                 |       |                            |
| 8MB                                                                         | <b>\$118.45</b> | 60809 | 16MB <b>\$149.82</b> 60810 |
| 8MB piggyback module                                                        | <b>\$97.34</b>  | 60810 |                            |
| TravelMate 5000, 5020, 5050, 5060 series                                    |                 |       |                            |
| 8MB                                                                         | <b>\$145.85</b> | 73562 | 16MB <b>\$159.72</b> 73563 |
| 32MB                                                                        | <b>\$308.89</b> | 73571 |                            |
| TOSHIBA                                                                     |                 |       |                            |
| Dynapad T200, T200C                                                         |                 |       |                            |
| 8MB                                                                         | <b>\$78.54</b>  | 31608 | 16MB <b>\$148.90</b> 33132 |
| Equium S1600, S2000, S2000                                                  |                 |       |                            |
| 8MB                                                                         | <b>\$85.00</b>  | 67225 | 16MB <b>\$119.84</b> 67227 |
| Infra 7130, 7150, 7161, 7200, 7201, 7220                                    |                 |       |                            |
| 8MB                                                                         | <b>\$85.10</b>  | 76190 | 16MB <b>\$119.80</b> 76191 |
| Portege 500, 500, CDT, Teora 500, 510 series, 730 series and 740 series     |                 |       |                            |
| 8MB                                                                         | <b>\$85.10</b>  | 72535 | 16MB <b>\$129.12</b> 72534 |
| Portege 510, Teora 710, 720, 730 series, Satellite Pro 500, 420, 490 series |                 |       |                            |
| 8MB                                                                         | <b>\$85.00</b>  | 67892 | 16MB <b>\$144.76</b> 67893 |
| 32MB                                                                        | <b>\$278.80</b> | 67894 |                            |
| Satellite 100, 100, Satellite Pro 400, 410 series                           |                 |       |                            |
| 8MB                                                                         | <b>\$85.00</b>  | 63080 | 16MB <b>\$144.76</b> 63087 |
| 32MB                                                                        | <b>\$278.80</b> | 61117 |                            |
| Satellite 110, 110, 200CD, Satellite Pro 430CD, 430CD                       |                 |       |                            |
| 8MB                                                                         | <b>\$85.00</b>  | 67892 | 16MB <b>\$144.76</b> 67893 |
| 32MB                                                                        | <b>\$278.80</b> | 67894 |                            |
| T2100, T2100                                                                |                 |       |                            |
| 4MB                                                                         | <b>\$85.00</b>  | 52810 | 8MB <b>\$75.80</b> 52811   |
| 16MB                                                                        | <b>\$134.82</b> | 52812 | 24MB <b>\$199.84</b> 52813 |
| Teora 510CDT, 510CD, Teora 500CDT, 520CDT, Satellite 230 CDB, Pro 490CDT    |                 |       |                            |
| 8MB                                                                         | <b>\$85.10</b>  | 72535 | 16MB <b>\$129.12</b> 72534 |
| 32MB                                                                        | <b>\$289.70</b> | 74895 |                            |

| FUJITSU                                                                                     |                 |       |                            |
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| Lithium 554T, 554T, 554T, 554T                                                              |                 |       |                            |
| 8MB                                                                                         | <b>\$71.85</b>  | 83130 | 16MB <b>\$128.70</b> 80786 |
| 32MB                                                                                        | <b>\$288.80</b> | 80426 |                            |
| GATEWAY 2000                                                                                |                 |       |                            |
| STO-PentPro-75, 90, 100, 120, 135, 150, 160, Family PC, P5-100, 120, 135, 150, 160 QuadCity |                 |       |                            |
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| HITACHI                                                                                     |                 |       |                            |
| MX series, 1307, 1307, 1307                                                                 |                 |       |                            |
| 8MB                                                                                         | <b>\$87.54</b>  | 85193 | 16MB <b>\$148.70</b> 85195 |

| ACER                                                   |                 |       |                            |
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| Extensa 400 series, 500 series, 500 series, 570 series |                 |       |                            |
| 8MB                                                    | <b>\$85.10</b>  | 50805 | 16MB <b>\$129.50</b> 50806 |
| Extensa 510, 510                                       |                 |       |                            |
| 8MB                                                    | <b>\$78.82</b>  | 72130 | 16MB <b>\$128.70</b> 72134 |
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| 8MB                                                    | <b>\$85.10</b>  | 50805 | 16MB <b>\$129.50</b> 50806 |
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| Server + 10-client license CD   | 999.96 |
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| Single-client license           | 29.86  |
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| Version up CD                   | 129.52 |
| Single-client upg               | 229.39 |
| Full version CD                 | 269.94 |

#### Novell

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| Connectix Color QuickCam V2.0              | 209.57  |
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| Epson PhotoPC 500 digital camera           | 499.00  |
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| Hewlett Packard ScanJet 5c                 | 239.57  |
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| Nikon CoolPix 300 digital camera           | 656.24  |
| Play Snappy video still capture            | 134.03  |
| Polaroid 2000/40 digital camera            | 2877.79 |
| Ricoh RDC-2 digital camera                 | 799.00  |
| UMAX PageOffice Color scanner              | 215.06  |
| UMAX Astra 600S scanner                    | 235.65  |
| UMAX Astra 1200S scanner w/PhotoDeluxe     | 438.58  |
| Visiometer PaperPort mx scanner            | 179.89  |
| Visiometer PaperPort lx scanner            | 179.37  |
| Visiometer PaperPort Strobe scanner        | 299.00  |

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| MAG Innovision 510V2 15" 0.28mm | 289.78  |
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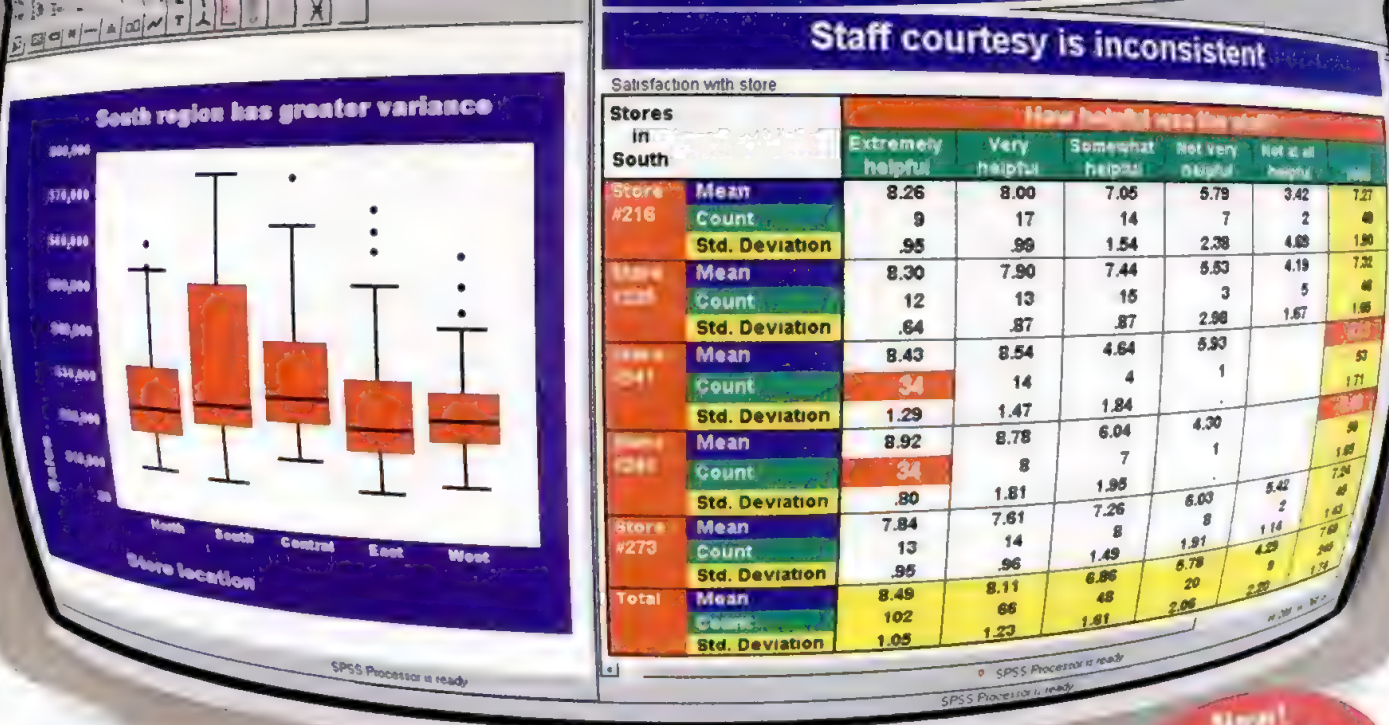
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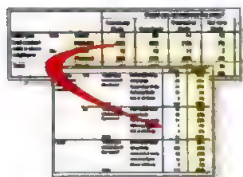
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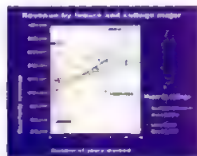
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**PC MAGAZINE:** This technique lets you put your company logo on every computer's System Properties page, along with essential information about getting help and support. Or you can personalize your own machine with the bitmap and text of your choice. Figure 1 shows the System Properties page with an imaginary company logo; next to it is an example of the support information dialog. Note that this tip is specific to Windows 95.

Windows 95 will treat all pixels that match the color of the logo's bottom-left pixel as transparent. That lets you display non rectangular images, like the one in Figure 1. But this feature can cause trouble if the image you want to use is rectangular. In that case, the best solution is to widen the image by one pixel, move the existing image one pixel to the right, and color the leftmost column of pixels with a color that isn't used in the existing image.

Figure 2 shows the OEMINFO.INI file that defines the support dialog shown in Figure 1. Windows looks for Line1, Line2, and so on, in order, stopping when a line number is not found. That's why the sequence of line numbers must be continuous. There's no clear limit on the number of lines; we successfully tested an OEMINFO.INI file with 1,000 lines. But anything over a few hundred caused an appreciable delay before the support information dialog appeared.

## Recovering a Shrunk Taskbar

*I recently encountered a small problem that may have frustrated other Windows 95 users as well: The Taskbar can end up sized too small for you to select anything. This can be caused by a sticky mouse button as you move over the Taskbar or simply by a mistake when you're attempting to select an item. Once it happens, you are unable to select any programs or resize the Taskbar with the mouse. But it is possible to correct the problem using the keyboard. Press Ctrl-Esc to select the Taskbar, then press Alt-Space in order to get the Taskbar menu. Now select*

```
[general]
Manufacturer=Rubenking Interplanetary
Model=Banana 9000

[Support Information]
Line1="Frequently asked questions:"
Line2=
Line3=" Q: Computer screen is blank - what's wrong?"
Line4=" A: Turn computer on."
Line5=""
Line6=" Q: It says to insert Disk 2, but I can't."
Line7=" A: First, remove Disk 1!"
Line8=
Line9=" Q: Where is the "Any" key?"
Line10=" A: Just press Enter!"
Line11=
Line12="For other questions, contact"
Line13=" Neil J. Rubenking, High Commander"
Line14=" high_commander@galaxyweb.sol.earth"
```

**FIGURE 2:** This sample OEMINFO.INI file produced the display that is shown in Figure 1.

*Size and press Enter, and use the Up Arrow key to enlarge the Taskbar. When you press Enter again, the Taskbar will be restored to its original size.*

JOE FAITH  
via the Internet

**PC MAGAZINE:** The Taskbar doesn't look like a regular program window. Since it doesn't have a title bar, it also doesn't have a system menu button at the left end of a title bar. Nonetheless, when you press Alt-Space, it behaves like any other main program window and displays its system menu. The only options enabled are Move, Size, and Close. As Mr. Faith has noted, you can resize a too-small Taskbar using the Size option. If you have a lot of patience, you can even move the Taskbar so that it docks at a different edge of the screen. Just choose Move from the system menu, press the appropriate arrow key again and again until the cursor reaches the desired location, and hit Enter. You'll know when the cursor is close enough, because an outline of the Taskbar will appear.

More interestingly, the Close command on the system menu invokes the standard Shut Down dialog, and the Close command has its own shortcut, Alt-F4. That means that pressing Ctrl-Esc followed by Alt-F4 is a quick way to invoke the Shut Down dialog.

## Organized Hotkeys

*One of Windows 95's best features is the ability to assign a hotkey to a shortcut. But after creating a few, I had a terrible time finding, editing, and organizing them. My solution? A folder*

*on my Start menu named Keystrokes. In it I placed a shortcut (or a copy of a shortcut) to every one of my major programs. I renamed each shortcut so its name began with the letter of its hotkey assignment instead of the actual program name. This approach also puts the list in alphabetical order, simplifying finding the shortcut I want. My Keystrokes folder contains the following items:*

*B Bookshelf  
C Calendar  
D MS-DOS  
E Encarta  
M cc:Mail  
Q Quicken  
W Word  
X Excel*

*I then right-clicked each shortcut, selected Properties, and selected Shortcut. In the Shortcut Key box, I held down the Ctrl and Alt keys while typing the letter of the shortcut's name.*

*Now Ctrl-Alt-B brings up Bookshelf no matter what I'm doing at the time, Ctrl-Alt-C brings up my PIM, and so forth. The only trick is that the folder containing these shortcuts must be on your Start menu or the hotkeys will not work.*

AL LOWE  
Seattle, Washington

**PC MAGAZINE:** The Shortcut page of the Properties dialog for every shortcut includes a box labeled "Shortcut key." This is somewhat misleading, because the shortcut key is effective only for shortcuts that are located on the desktop or in the Start menu. The only way to determine the hotkey for a given shortcut is to open its Properties dialog and take a look. Thus putting all of your hotkey-equipped shortcuts in a single folder is a great way to keep track of them.

Note that you don't have to remove the shortcuts for these important programs from their usual location in the Start menu—you can use a copy of each shortcut. Start by right-clicking the Start button and choosing Explore from the context menu. In the resulting Explorer window, open the Programs folder and navigate to the folder that contains the desired shortcut. Right-click on it and select Copy. Now right-click the Keystrokes folder and select Paste. Right-click the new shortcut, select Properties, and click on the Shortcut tab. Click in the Shortcut key box, press the desired key combination, and press OK. Finally, right-click the new shortcut, select Rename from the context menu, and give it a name that reflects the hotkey.



# Ask Our Advisors

## HARDWARE

### At the Sound of the Beep...

*PCs used to include documentation about BIOS power-on self-test (POST) beep codes, so that installers could determine what was wrong with a system that didn't completely boot. Where can I get my hands on the list of these codes?*

IZAK DEVILLIERS  
via the Internet

**PC MAGAZINE:** When the only BIOS in town was IBM's, the beep codes were easy to decipher, because they were all the same. With the advent of competing BIOS versions from companies such as AMI, Award, and Phoenix, the beep codes have proliferated, making it more difficult to keep track of them. Some BIOS versions have sophisticated codes that can diagnose many more problems than the simple graphics adapters and memory faults of early PCs. If your computer documentation doesn't include a list of the beep codes, tracking them down now can be worthwhile in case you need them to decipher a hardware failure that prevents your system from booting.

One easy way to decode the beeps for the most common BIOS versions is to use a handy printed reference called *Pocket PCRef*, by Thomas Glover and Millie Young (\$14.95; ISBN 1-885071-04-3; Sequoia Publishing, Littleton, CO; 800-873-7126; [www.sequoiapub.com/](http://www.sequoiapub.com/)). This pocket-size book is filled with other handy tidbits, such as the standard settings for COM ports, connector pinouts, DOS command syntax, and hard disk parameters. If you deal with computer hardware, you'll frequently find yourself referring to this useful book.

You may also be able to find the beep codes you need on the Web. For example, a site called System Optimization Information ([www.sysopt.com/index.html](http://www.sysopt.com/index.html)) contains lots of useful information about hardware configuration, including details about the beep codes for some BIOS versions. It also has links to other hardware sites, including those of many of the BIOS manufacturers.—Alfred Poor

## OPERATING ENVIRONMENTS

### Setting the Color Depth in Windows 95

*After installing Windows 95, I found the color palette set to just 16 colors; the only other choice is monochrome. Under Windows 3.1,*

*the palette was 256 colors. How can I change the palette to 256 colors so that I can use Adobe Photoshop?*

JENNY YAN  
via the Internet

**PC MAGAZINE:** Windows 95 wasn't able to recognize your display adapter, so it assumed only the most basic capabilities. In most cases you can easily fix such a problem by telling Windows 95 what kind of display hardware you have. To do this, right-click the desktop, select Properties from the context menu, pick the Settings tab in the resulting dialog, and press the Change Display Type button. Press the Change button next to Adapter Type and choose your video adapter from the list. Then try the Change button next to Monitor Type and choose your monitor from the list. You may need to restart the system at this point. Now you should be able to select the 256-color modes you were accustomed to using before Windows 95 without any problems.

Occasionally you'll find that Windows 95 simply doesn't have a driver that works with your particular display adapter, especially if the adapter is old. In that case, you may be able to use your Windows 3.1 driver. Again bring up the Display Properties dialog, pick the Settings tab, press the Change Display Type button, and press the Change button next to Adapter Type. In the Select Device dialog, press the Have Disk... button. Locate the floppy disk containing your Windows 3.1 display drivers, put it in the disk drive, and press OK. If you can't find the disk, try entering the full pathname of your Windows 3.1 system directory. Now select the same driver you used under Windows 3.1.

—Neil J. Rubenking

### Compression Confusion

*I run Windows 95 with Microsoft Plus! installed. I'd like to compress my 1.6GB hard disk, but I'm confused. The properties report indicates 784MB of disk space used, 763MB free. When I query about compressing the drive, the report says:*

1. Compress drive C: to free up 1217.74MB, or
2. Compress the free space only on C: to a new drive F:, freeing up 1973.48MB of space.

*How can compressing only part of the drive free up more disk space than compressing the entire drive?*

JOEL SCHWARTZ  
via the Internet

**PC MAGAZINE:** The version of DriveSpace shipped with Windows 95 is limited to creating compressed volumes up to 512MB, holding roughly 1GB of data. When estimating compression results for drives that are bigger than 512MB, DriveSpace can produce anomalous results. The report really should have said that your drive C: is too large for DriveSpace to compress completely, and even the free space on drive C: is too large for a single compressed volume.

Since you have Microsoft Plus!, I'd suggest upgrading to DriveSpace 3, which raises the maximum size for compressed volume files to 2GB. Failing that, create multiple compressed volumes on drive C:, each no larger than 512MB.—Neil J. Rubenking

## WORD PROCESSING

### Inserting the File Date and Time in WordPerfect 7

*In the March 7, 1997, issue of PC Magazine, M. David Stone showed how to use the Date-Text command in a WordPerfect macro to insert the current date into a file as text rather*

## OUR ADVISORS

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**M. David Stone** is a contributing editor and the coauthor of *Word for Windows Companion, Second Edition*.



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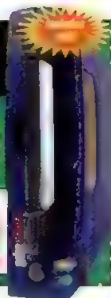
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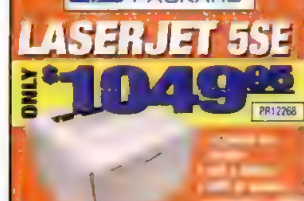


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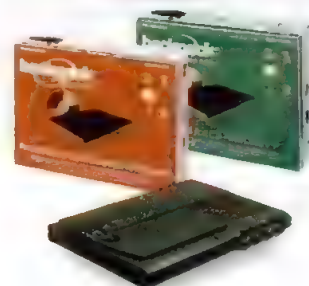


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# PCTech Ask Our Advisors

```
Application (WordPerfect:  
"WordPerfect"; Default; "US")  
FootnoteCreate  
FontSize (FontSize: 7p)  
vName=?Path+?Name  
vNumber = GetFileDateAndTime(vName)  
vDate = DateString(vNumber)  
vTime = TimeString(vNumber)  
Type(vName + "    Last Modified: "  
+ vDate + " " + vTime)  
SubstructureExit  
Print  
MESSAGEBOX(x; "REMINDER": "Don't  
Forget to Delete Footnote After  
Printing"; IconExclamation!)
```

**FIGURE 1:** This WordPerfect 7 macro will enter the current file's last-saved date in a footnote, and it will then print the file and remind you to delete the footnote.

than as a code that updates every time you open the file. I'd like to do something similar: insert a footnote with the file's name and path and the date and time it was last changed. That way I could look at the footnote on a printout to see when the file was last updated and where it's located. Is there a code or a macro command that can insert the date and time of the last update, so I don't have to update the footnote manually every time I update the file?

CRISTOTI A. REDULLA  
Manhattan, Kansas

**PC MAGAZINE:** WordPerfect does not offer a code that you can insert once and have it automatically update when you edit and save the file. That means you're stuck having to update the footnote yourself. If you're using WordPerfect 7 for Windows, however, you can handle the task relatively painlessly with the macro in Figure 1. (You'll find the macro on PC Magazine Online as CRDATE.WCM.)

The underlying assumptions for this macro are that it's easier to remember to update the time stamp when you print than when you modify and save the file, and it's even easier to remember if you update the time stamp and print in a single step. If you print by way of this macro, it will update the time stamp, print the file, and remind you to remove the footnote so you won't accidentally get an outdated time stamp later if you print without the macro.

To use the macro, move the cursor to the position where you want the footnote reference, run the macro, and then delete the footnote when you're finished printing. Most of the action in the macro takes place between the FootnoteCreate command (which inserts the

footnote) and the SubstructureExit command (which returns to the body of the document).

The first line after the FootnoteCreate command sets the font size to 7 points. You can change the size if you prefer. If you want the footnote to be the same size as the body text, delete the line entirely.

The next line creates the variable vName and sets it to match the full path, including drive letter, and name of the current file. (Both ?Path and ?Name are WordPerfect system variables.) The macro then creates the variable vNumber and uses the GetFileDateAndTime command to set vNumber to the number WordPerfect uses to represent the date and time of the current file. DateString and TimeString in the next two lines convert the vNumber value to the appropriate date and time, using the variables vDate and vTime. The last line before the SubstructureExit command uses the Type command to enter the drive, path, and filename, along with the file date and time.

Then the macro prints the document. The Print command will use the current print settings, whatever they happen to be. You may want to modify this by recording a print run complete with the specific settings to use.

Finally, the MessageBox command puts a message on the screen reminding you to delete the footnote after printing. You could modify the macro to delete the footnote automatically, but the macro as it's written gives you options such as checking the page breaks and printing additional copies before deleting the footnote.

**Note:** This macro will not work in earlier versions of WordPerfect. —M. David Stone

## SPREADSHEETS

### Excel Charts with Y Series From Multiple Worksheets

*I am analyzing the life-course trajectories of a group of individuals and have each individual's data stored on a separate worksheet. On each sheet, column A represents time. Columns B, C, and D show particular event types. The cells in each of these columns have numerical values if the event occurred and are blank if the event did not occur. Figure 2 shows an example of the data and chart for one individual. Other sheets on this worksheet contain similar data and charts for other individuals.*

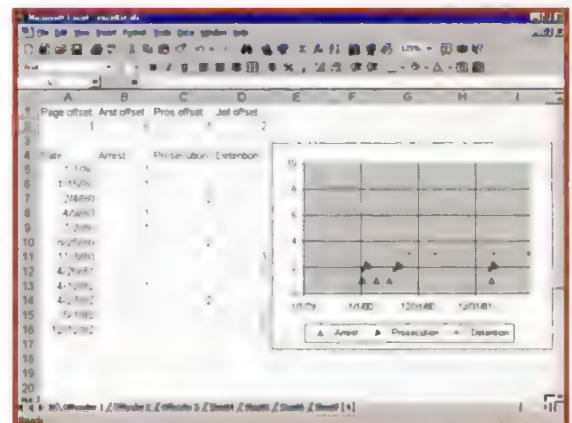
*In Quattro Pro you can easily plot all the*

*individuals' trajectories on the same graph, simply by defining the x variable as A..D:A2..A51 (assuming there are four individuals and 50 data points) and the various y variables similarly. Is there a way to do this in Excel? How many trajectories can I add to a chart?*

MICHAEL D. MALTZ  
mikem@uic.edu

**PC MAGAZINE:** Yes. The chart shown in Figure 2 is an XY (scatter) chart with the x-values in column A and three Y series in columns B through D. If you paste the A5:D16 ranges from sheets 2 and 3 onto this chart, for example, the B, C, and D columns on sheets 2 and 3 will become additional Y series, and Excel will build a single X series from the A-column values on all three sheets.

The simplest way to do this, in both Excel 97 and recent prior versions, is as follows: After creating the graph shown in Figure 2, go to Sheet 2 and select the data you want to add. Don't forget to include the x-values (column



**FIGURE 2:** The Excel XY (scatter) chart on the right was created from the series on the left.

A). Press Ctrl-C to copy this data to the Clipboard, return to Sheet 1, select the chart, and press Ctrl-V to paste. Repeat for Sheet 3. Finally, double-click a data point on each of the chart's new series, and format to taste.

This process works fine when the number of data points in each new series is greater than the number of new series. Excel then knows that you're adding series to the chart, not points to existing series. If for some reason Excel does not get this right, use Paste Special instead of Paste when adding the new data. In the Paste Special dialog box, choose Add Cells as New Series.

The nominal data-series limit for Excel charts is 255. I say nominal, because I've never been able to get Excel 97 to build a large 255-series chart without crashing (on a machine with 32MB of RAM). The actual limit may be memory-dependent. —Craig Stinson







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### Creating Pages of Labels

*I have 60 different addresses for which I would like to create labels. I want to put each of them onto a separate page, so that each page is filled with one address label. How can I do this using Microsoft Access 95 or 97?*

GORDON LI  
New York, New York

**PC MAGAZINE:** Normally when Access prints a label report, it advances to the next record after every label. You need Access to advance to the next record only after a full page. You can do this by attaching a procedure to the Print event in the detail section of your report. Within this procedure you set the NextRecord property to either True or False. Access calls the Print event prior to printing each label, and it uses the NextRecord property to determine whether to advance to the next record. By setting NextRecord to False you prevent Access from advancing to the next record after printing the current one; this way, Access will keep printing the same record until you set NextRecord to True.

Figure 3 shows one solution, designed for a typical Avery 5160 label format with 30 labels per page. The routine checks the PrintCount property, which Access sets to the number of times the Print event has been processed, to see when 30 labels have been printed. Until then the NextRecord property is set to False so that Access stays on the current record. When

```
Option Compare Database
Option Explicit
```

```
Private Sub Detail_Print(Cancel As Integer, PrintCount As Integer)
If Me.PrintCount Mod 30 = 0 Then ' After every thirty
                                ' labels
    Me.NextRecord = True         ' Advance to the next row
Else                             ' Otherwise
    Me.NextRecord = False       ' Don't advance to the
                                ' next row
End If
End Sub
```

**FIGURE 3:** You can use the code shown here in your Access report to print entire pages of the same address label.

PrintCount becomes an even multiple of 30, a new page has been finished, so NextRecord is set to True and Access advances to the next record. (The Mod operator returns the remainder after division, so the PrintCount Mod 30 in the If statement will return 0 only when PrintCount is a multiple of 30.)

If your label report doesn't print 30 labels

```
Option Compare Database
Option Explicit
```

```
Public GetNextRow As Boolean
```

```
Private Sub Detail_Print(Cancel As Integer, PrintCount As Integer)
If GetNextRow = True Then      ' If it's time to advance
    Me.NextRecord = True       ' Then advance to the next row
    Me.MoveLayout = False      ' But stay in this position
    Me.PrintSection = False    ' and don't print anything
    GetNextRow = False         ' Reset to false
Else                             ' Otherwise
    Me.NextRecord = False      ' Don't advance to the next row
End If
End Sub
```

```
Private Sub Report_Open(Cancel As Integer)
GetNextRow = False
End Sub
```

```
Private Sub Report_Page()
GetNextRow = True
End Sub
```

**FIGURE 4:** You can use this code in your Access report to print entire pages of an address label. Although it is more complex than the code in Figure 3, it does not require that you hard-code the number of labels per page.

per page, you must change the 30 to match the number in your own report design. Thus the technique in Figure 3 is preferred only when you're comfortable hard-coding the number of labels per page.

Figure 4 shows a more complex technique that doesn't require that hard-coding. It works by creating a GetNextRow variable to signal when to set NextRecord to True to advance to the next record. The variable is first initialized to False when the report is opened, in an event procedure attached to the report's Open event. At the end of each page the variable is set to True, in an event procedure attached to the report's Page event. Finally, as with the first technique, you attach an event procedure to the Detail section's Print event. It determines whether to set NextRecord to True or False by referring to the GetNextRow variable. It's also responsible for resetting the GetNextRow variable to False at the beginning of a new page.

Thus the NextRecord signal is turned off at the beginning of the report, turned on at the

end of a page, and turned off again at the beginning of the next page after triggering the record movement.

The easiest way to create the code in Figure 3 or 4 is to open your label report in design mode, then select the View menu and choose Code. Type in the code as it appears here. When you're finished, select the File menu and choose Close to save your changes.

—Sal Ricciardi

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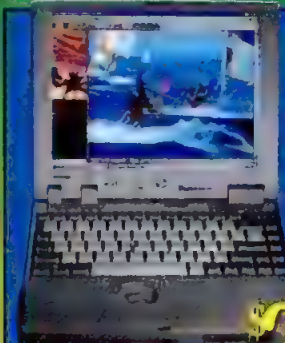
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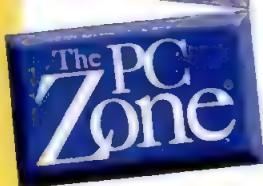
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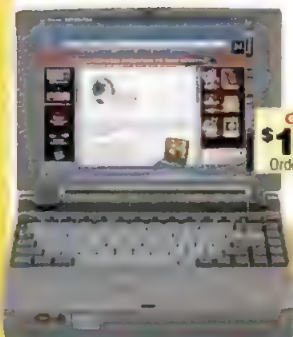








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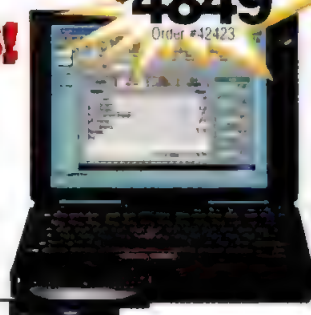
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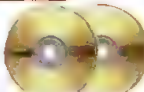
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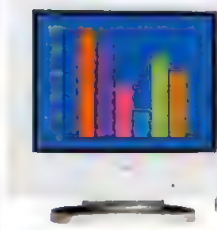
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280B

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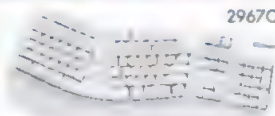
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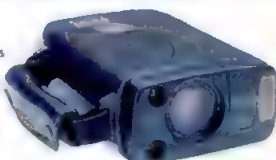
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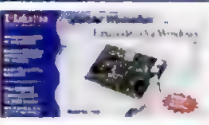


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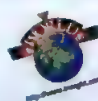
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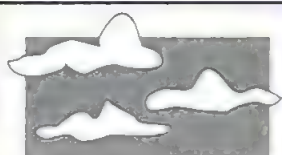
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|------------------------------------------|------------|
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| Boards/Components/Chips .....            | 290 ...305 |
| Communications .....                     | 293 ...307 |
| Computer Systems .....                   | 294        |
| Input/Data Acquisition/Barcode/POS ..... | 295 ...308 |
| Mass Storage Devices .....               | 295        |
| Multi-Media .....                        | 297        |
| Networking .....                         | 297        |
| Peripherals .....                        | 297 ...311 |
| Power Supplies .....                     | 311        |
| Security .....                           | 311        |

### SOFTWARE

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|                               |            |
|-------------------------------|------------|
| Barcode .....                 | 312        |
| Business Applications.....    | 298 ...312 |
| Business Utilities .....      | 298        |
| CD-ROM Titles .....           | 312        |
| Communications .....          | 312        |
| Education .....               | 299 ...312 |
| Financial/Accounting .....    | 302        |
| Internet Tools/Utilities..... | 312        |
| Multi-Media .....             | 301        |
| Religion .....                | 312        |

|                               |     |
|-------------------------------|-----|
| Security .....                | 313 |
| Shareware/Public Domain ..... | 302 |
| Adult.....                    | 317 |

### SERVICES

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|                                     |     |
|-------------------------------------|-----|
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| On-Line .....                       | 302 |
| Software Duplication .....          | 315 |

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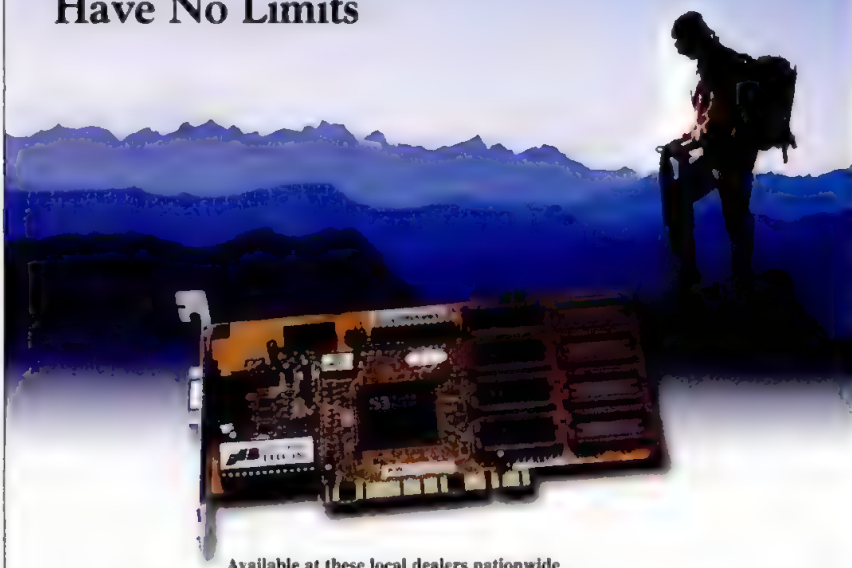
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|------------------------------|-----|
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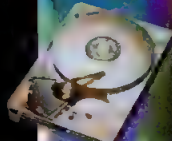
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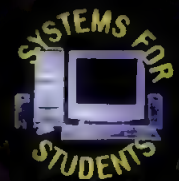
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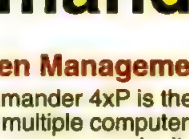
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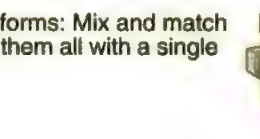
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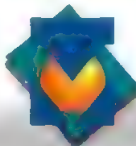
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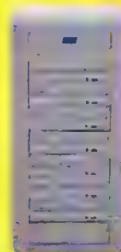
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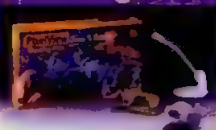
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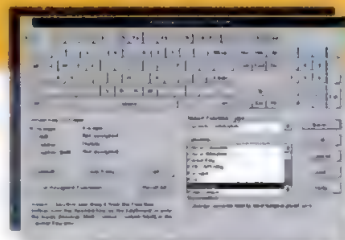
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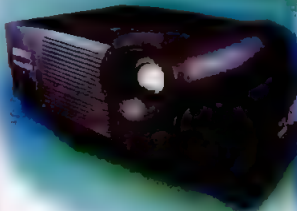


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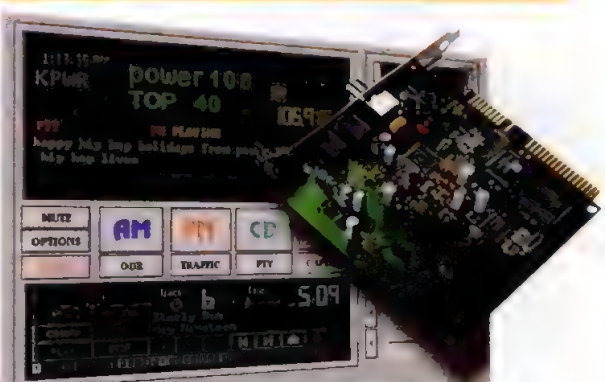
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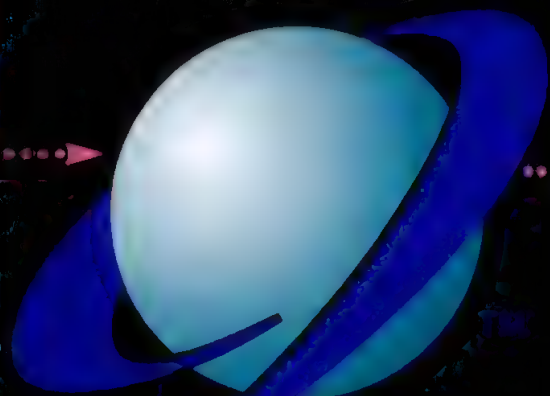
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| 1) INTEL 100MHz CPU     | 1) AMD K5 200 - KIT (\$499) |
| 2) INTEL VIO MB 512 PLB | 2) INTEL TX MB 512 PLB      |
| 3) 32MB 80NS EDO 72PIN  | 3) 32MB 80NS EDO 72PIN      |
| 4) STEALTH 64 3D 4MB    | 4) STEALTH 64 3D 4MB        |
| 5) ARDE 2FD 1EPP 2HS    | 5) ARDE 2FD 1EPP 2HS        |
| 6) CASE 230W 5 BAYS     | 6) CASE 230W 5 BAYS         |

**AMD K5 233 - KIT (\$499)**

|                         |                             |
|-------------------------|-----------------------------|
| 1) INTEL 100MHz CPU     | 1) AMD K5 233 - KIT (\$499) |
| 2) INTEL VIO MB 512 PLB | 2) INTEL TX MB 512 PLB      |
| 3) 32MB 80NS EDO 72PIN  | 3) 32MB 80NS EDO 72PIN      |
| 4) STEALTH 64 3D 4MB    | 4) STEALTH 64 3D 4MB        |
| 5) ARDE 2FD 1EPP 2HS    | 5) ARDE 2FD 1EPP 2HS        |
| 6) CASE 230W 5 BAYS     | 6) CASE 230W 5 BAYS         |

**AMD K5 266 - KIT (\$499)**

|                         |                             |
|-------------------------|-----------------------------|
| 1) INTEL 100MHz CPU     | 1) AMD K5 266 - KIT (\$499) |
| 2) INTEL VIO MB 512 PLB | 2) INTEL TX MB 512 PLB      |
| 3) 32MB 80NS EDO 72PIN  | 3) 32MB 80NS EDO 72PIN      |
| 4) STEALTH 64 3D 4MB    | 4) STEALTH 64 3D 4MB        |
| 5) ARDE 2FD 1EPP 2HS    | 5) ARDE 2FD 1EPP 2HS        |
| 6) CASE 230W 5 BAYS     | 6) CASE 230W 5 BAYS         |

**AMD K5 300 - KIT (\$499)**

|                         |                             |
|-------------------------|-----------------------------|
| 1) INTEL 100MHz CPU     | 1) AMD K5 300 - KIT (\$499) |
| 2) INTEL VIO MB 512 PLB | 2) INTEL TX MB 512 PLB      |
| 3) 32MB 80NS EDO 72PIN  | 3) 32MB 80NS EDO 72PIN      |
| 4) STEALTH 64 3D 4MB    | 4) STEALTH 64 3D 4MB        |
| 5) ARDE 2FD 1EPP 2HS    | 5) ARDE 2FD 1EPP 2HS        |
| 6) CASE 230W 5 BAYS     | 6) CASE 230W 5 BAYS         |

**AMD K5 333 - KIT (\$499)**

|                         |                             |
|-------------------------|-----------------------------|
| 1) INTEL 100MHz CPU     | 1) AMD K5 333 - KIT (\$499) |
| 2) INTEL VIO MB 512 PLB | 2) INTEL TX MB 512 PLB      |
| 3) 32MB 80NS EDO 72PIN  | 3) 32MB 80NS EDO 72PIN      |
| 4) STEALTH 64 3D 4MB    | 4) STEALTH 64 3D 4MB        |
| 5) ARDE 2FD 1EPP 2HS    | 5) ARDE 2FD 1EPP 2HS        |
| 6) CASE 230W 5 BAYS     | 6) CASE 230W 5 BAYS         |

**AMD K5 366 - KIT (\$499)**

|                         |                             |
|-------------------------|-----------------------------|
| 1) INTEL 100MHz CPU     | 1) AMD K5 366 - KIT (\$499) |
| 2) INTEL VIO MB 512 PLB | 2) INTEL TX MB 512 PLB      |
| 3) 32MB 80NS EDO 72PIN  | 3) 32MB 80NS EDO 72PIN      |
| 4) STEALTH 64 3D 4MB    | 4) STEALTH 64 3D 4MB        |
| 5) ARDE 2FD 1EPP 2HS    | 5) ARDE 2FD 1EPP 2HS        |
| 6) CASE 230W 5 BAYS     | 6) CASE 230W 5 BAYS         |

**AMD K5 400 - KIT (\$499)**

|                         |                             |
|-------------------------|-----------------------------|
| 1) INTEL 100MHz CPU     | 1) AMD K5 400 - KIT (\$499) |
| 2) INTEL VIO MB 512 PLB | 2) INTEL TX MB 512 PLB      |
| 3) 32MB 80NS EDO 72PIN  | 3) 32MB 80NS EDO 72PIN      |
| 4) STEALTH 64 3D 4MB    | 4) STEALTH 64 3D 4MB        |
| 5) ARDE 2FD 1EPP 2HS    | 5) ARDE 2FD 1EPP 2HS        |
| 6) CASE 230W 5 BAYS     | 6) CASE 230W 5 BAYS         |

**AMD K5 450 - KIT (\$499)**

|                         |                             |
|-------------------------|-----------------------------|
| 1) INTEL 100MHz CPU     | 1) AMD K5 450 - KIT (\$499) |
| 2) INTEL VIO MB 512 PLB | 2) INTEL TX MB 512 PLB      |
| 3) 32MB 80NS EDO 72PIN  | 3) 32MB 80NS EDO 72PIN      |
| 4) STEALTH 64 3D 4MB    | 4) STEALTH 64 3D 4MB        |
| 5) ARDE 2FD 1EPP 2HS    | 5) ARDE 2FD 1EPP 2HS        |
| 6) CASE 230W 5 BAYS     | 6) CASE 230W 5 BAYS         |

**AMD K5 500 - KIT (\$499)**

|                         |                             |
|-------------------------|-----------------------------|
| 1) INTEL 100MHz CPU     | 1) AMD K5 500 - KIT (\$499) |
| 2) INTEL VIO MB 512 PLB | 2) INTEL TX MB 512 PLB      |
| 3) 32MB 80NS EDO 72PIN  | 3) 32MB 80NS EDO 72PIN      |
| 4) STEALTH 64 3D 4MB    | 4) STEALTH 64 3D 4MB        |
| 5) ARDE 2FD 1EPP 2HS    | 5) ARDE 2FD 1EPP 2HS        |
| 6) CASE 230W 5 BAYS     | 6) CASE 230W 5 BAYS         |

**AMD K5 550 - KIT (\$499)**

|                         |                             |
|-------------------------|-----------------------------|
| 1) INTEL 100MHz CPU     | 1) AMD K5 550 - KIT (\$499) |
| 2) INTEL VIO MB 512 PLB | 2) INTEL TX MB 512 PLB      |
| 3) 32MB 80NS EDO 72PIN  | 3) 32MB 80NS EDO 72PIN      |
| 4) STEALTH 64 3D 4MB    | 4) STEALTH 64 3D 4MB        |
| 5) ARDE 2FD 1EPP 2HS    | 5) ARDE 2FD 1EPP 2HS        |
| 6) CASE 230W 5 BAYS     | 6) CASE 230W 5 BAYS         |

**AMD K5 600 - KIT (\$499)**

|                         |                             |
|-------------------------|-----------------------------|
| 1) INTEL 100MHz CPU     | 1) AMD K5 600 - KIT (\$499) |
| 2) INTEL VIO MB 512 PLB | 2) INTEL TX MB 512 PLB      |
| 3) 32MB 80NS EDO 72PIN  | 3) 32MB 80NS EDO 72PIN      |
| 4) STEALTH 64 3D 4MB    | 4) STEALTH 64 3D 4MB        |
| 5) ARDE 2FD 1EPP 2HS    | 5) ARDE 2FD 1EPP 2HS        |
| 6) CASE 230W 5 BAYS     | 6) CASE 230W 5 BAYS         |

**AMD K5 666 - KIT (\$499)**

|                         |                             |
|-------------------------|-----------------------------|
| 1) INTEL 100MHz CPU     | 1) AMD K5 666 - KIT (\$499) |
| 2) INTEL VIO MB 512 PLB | 2) INTEL TX MB 512 PLB      |
| 3) 32MB 80NS EDO 72PIN  | 3) 32MB 80NS EDO 72PIN      |
| 4) STEALTH 64 3D 4MB    | 4) STEALTH 64 3D 4MB        |
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**AMD K5 700 - KIT (\$499)**

|                         |                             |
|-------------------------|-----------------------------|
| 1) INTEL 100MHz CPU     | 1) AMD K5 700 - KIT (\$499) |
| 2) INTEL VIO MB 512 PLB | 2) INTEL TX MB 512 PLB      |
| 3) 32MB 80NS EDO 72PIN  | 3) 32MB 80NS EDO 72PIN      |
| 4) STEALTH 64 3D 4MB    | 4) STEALTH 64 3D 4MB        |
| 5) ARDE 2FD 1EPP 2HS    | 5) ARDE 2FD 1EPP 2HS        |
| 6) CASE 230W 5 BAYS     | 6) CASE 230W 5 BAYS         |

**AMD K5 750 - KIT (\$499)**

|                         |                             |
|-------------------------|-----------------------------|
| 1) INTEL 100MHz CPU     | 1) AMD K5 750 - KIT (\$499) |
| 2) INTEL VIO MB 512 PLB | 2) INTEL TX MB 512 PLB      |
| 3) 32MB 80NS EDO 72PIN  | 3) 32MB 80NS EDO 72PIN      |
| 4) STEALTH 64 3D 4MB    | 4) STEALTH 64 3D 4MB        |
| 5) ARDE 2FD 1EPP 2HS    | 5) ARDE 2FD 1EPP 2HS        |
| 6) CASE 230W 5 BAYS     | 6) CASE 230W 5 BAYS         |

**AMD K5 800 - KIT (\$499)**

|                         |                             |
|-------------------------|-----------------------------|
| 1) INTEL 100MHz CPU     | 1) AMD K5 800 - KIT (\$499) |
| 2) INTEL VIO MB 512 PLB | 2) INTEL TX MB 512 PLB      |
| 3) 32MB 80NS EDO 72PIN  | 3) 32MB 80NS EDO 72PIN      |
| 4) STEALTH 64 3D 4MB    | 4) STEALTH 64 3D 4MB        |
| 5) ARDE 2FD 1EPP 2HS    | 5) ARDE 2FD 1EPP 2HS        |
| 6) CASE 230W 5 BAYS     | 6) CASE 230W 5 BAYS         |

**AMD K5 866 - KIT (\$499)**

|                         |                             |
|-------------------------|-----------------------------|
| 1) INTEL 100MHz CPU     | 1) AMD K5 866 - KIT (\$499) |
| 2) INTEL VIO MB 512 PLB | 2) INTEL TX MB 512 PLB      |
| 3) 32MB 80NS EDO 72PIN  | 3) 32MB 80NS EDO 72PIN      |
| 4) STEALTH 64 3D 4MB    | 4) STEALTH 64 3D 4MB        |
| 5) ARDE 2FD 1EPP 2HS    | 5) ARDE 2FD 1EPP 2HS        |
| 6) CASE 230W 5 BAYS     | 6) CASE 230W 5 BAYS         |

**AMD K5 900 - KIT (\$499)**

|                         |                             |
|-------------------------|-----------------------------|
| 1) INTEL 100MHz CPU     | 1) AMD K5 900 - KIT (\$499) |
| 2) INTEL VIO MB 512 PLB | 2) INTEL TX MB 512 PLB      |
| 3) 32MB 80NS EDO 72PIN  | 3) 32MB 80NS EDO 72PIN      |
| 4) STEALTH 64 3D 4MB    | 4) STEALTH 64 3D 4MB        |
| 5) ARDE 2FD 1EPP 2HS    | 5) ARDE 2FD 1EPP 2HS        |
| 6) CASE 230W 5 BAYS     | 6) CASE 230W 5 BAYS         |

**AMD K5 950 - KIT (\$499)**

|                         |                             |
|-------------------------|-----------------------------|
| 1) INTEL 100MHz CPU     | 1) AMD K5 950 - KIT (\$499) |
| 2) INTEL VIO MB 512 PLB | 2) INTEL TX MB 512 PLB      |
| 3) 32MB 80NS EDO 72PIN  | 3) 32MB 80NS EDO 72PIN      |
| 4) STEALTH 64 3D 4MB    | 4) STEALTH 64 3D 4MB        |
| 5) ARDE 2FD 1EPP 2HS    | 5) ARDE 2FD 1EPP 2HS        |
| 6) CASE 230W 5 BAYS     | 6) CASE 230W 5 BAYS         |

**AMD K5 1000 - KIT (\$499)**

|                         |                              |
|-------------------------|------------------------------|
| 1) INTEL 100MHz CPU     | 1) AMD K5 1000 - KIT (\$499) |
| 2) INTEL VIO MB 512 PLB | 2) INTEL TX MB 512 PLB       |
| 3) 32MB 80NS EDO 72PIN  | 3) 32MB 80NS EDO 72PIN       |
| 4) STEALTH 64 3D 4MB    | 4) STEALTH 64 3D 4MB         |
| 5) ARDE 2FD 1EPP 2HS    | 5) ARDE 2FD 1EPP 2HS         |
| 6) CASE 230W 5 BAYS     | 6) CASE 230W 5 BAYS          |

**AMD K5 1066 - KIT (\$499)**

|                         |                              |
|-------------------------|------------------------------|
| 1) INTEL 100MHz CPU     | 1) AMD K5 1066 - KIT (\$499) |
| 2) INTEL VIO MB 512 PLB | 2) INTEL TX MB 512 PLB       |
| 3) 32MB 80NS EDO 72PIN  | 3) 32MB 80NS EDO 72PIN       |
| 4) STEALTH 64 3D 4MB    | 4) STEALTH 64 3D 4MB         |
| 5) ARDE 2FD 1EPP 2HS    | 5) ARDE 2FD 1EPP 2HS         |
| 6) CASE 230W 5 BAYS     | 6) CASE 230W 5 BAYS          |

**AMD K5 1100 - KIT (\$499)**

|                         |                              |
|-------------------------|------------------------------|
| 1) INTEL 100MHz CPU     | 1) AMD K5 1100 - KIT (\$499) |
| 2) INTEL VIO MB 512 PLB | 2) INTEL TX MB 512 PLB       |
| 3) 32MB 80NS EDO 72PIN  | 3) 32MB 80NS EDO 72PIN       |
| 4) STEALTH 64 3D 4MB    | 4) STEALTH 64 3D 4MB         |
| 5) ARDE 2FD 1EPP 2HS    | 5) ARDE                      |



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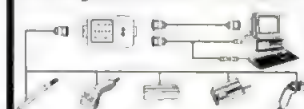
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Code 117, Code 118, Code 119, Code 120, Code 121, Code 122, Code 123, Code 124, Code 125, Code 126, Code 127, Code 128, Code 129, Code 130, Code 131, Code 132, Code 133, Code 134, Code 135, Code 136, Code 137, Code 138, Code 139, Code 140, Code 141, Code 142, Code 143, Code 144, Code 145, Code 146, Code 147, Code 148, Code 149, Code 150, Code 151, Code 152, Code 153, Code 154, Code 155, Code 156, Code 157, Code 158, Code 159, Code 160, Code 161, Code 162, Code 163, Code 164, Code 165, Code 166, Code 167, Code 168, Code 169, Code 170, Code 171, Code 172, Code 173, Code 174, Code 175, Code 176, Code 177, Code 178, Code 179, Code 180, Code 181, Code 182, Code 183, Code 184, Code 185, Code 186, Code 187, Code 188, Code 189, Code 190, Code 191, Code 192, Code 193, Code 194, Code 195, Code 196, Code 197, Code 198, Code 199, Code 200, Code 201, Code 202, Code 203, Code 204, Code 205, Code 206, Code 207, Code 208, Code 209, Code 210, Code 211, Code 212, Code 213, Code 214, Code 215, Code 216, Code 217, Code 218, Code 219, Code 220, Code 221, Code 222, Code 223, Code 224, Code 225, Code 226, Code 227, Code 228, Code 229, Code 230, Code 231, Code 232, Code 233, Code 234, Code 235, Code 236, Code 237, Code 238, Code 239, Code 240, Code 241, Code 242, Code 243, Code 244, Code 245, Code 246, Code 247, Code 248, Code 249, Code 250, Code 251, Code 252, Code 253, Code 254, Code 255, Code 256, Code 257, Code 258, Code 259, Code 260, Code 261, Code 262, Code 263, Code 264, Code 265, Code 266, Code 267, Code 268, Code 269, Code 270, Code 271, Code 272, Code 273, Code 274, Code 275, Code 276, Code 277, Code 278, Code 279, Code 280, Code 281, Code 282, Code 283, Code 284, Code 285, Code 286, Code 287, Code 288, Code 289, Code 290, Code 291, Code 292, Code 293, Code 294, Code 295, Code 296, Code 297, Code 298, Code 299, Code 300, Code 301, Code 302, Code 303, Code 304, Code 305, Code 306, Code 307, Code 308, Code 309, Code 310, Code 311, Code 312, Code 313, Code 314, Code 315, Code 316, Code 317, Code 318, Code 319, Code 320, Code 321, Code 322, Code 323, Code 324, Code 325, Code 326, Code 327, Code 328, Code 329, Code 330, Code 331, Code 332, Code 333, Code 334, Code 335, Code 336, Code 337, Code 338, Code 339, Code 340, Code 341, Code 342, Code 343, Code 344, Code 345, Code 346, Code 347, Code 348, Code 349, Code 350, Code 351, Code 352, Code 353, Code 354, Code 355, Code 356, Code 357, Code 358, Code 359, Code 360, Code 361, Code 362, Code 363, Code 364, Code 365, Code 366, Code 367, Code 368, Code 369, Code 370, Code 371, Code 372, Code 373, Code 374, Code 375, Code 376, Code 377, Code 378, Code 379, Code 380, Code 381, Code 382, Code 383, Code 384, Code 385, Code 386, Code 387, Code 388, Code 389, Code 390, Code 391, Code 392, Code 393, Code 394, Code 395, Code 396, Code 397, Code 398, Code 399, Code 400, Code 401, Code 402, Code 403, Code 404, Code 405, Code 406, Code 407, Code 408, Code 409, Code 410, Code 411, Code 412, Code 413, Code 414, Code 415, Code 416, Code 417, Code 418, Code 419, Code 420, Code 421, Code 422, Code 423, Code 424, Code 425, Code 426, Code 427, Code 428, Code 429, Code 430, Code 431, Code 432, Code 433, Code 434, Code 435, Code 436, Code 437, Code 438, Code 439, Code 440, Code 441, Code 442, Code 443, Code 444, Code 445, Code 446, Code 447, Code 448, Code 449, Code 450, Code 451, Code 452, Code 453, Code 454, Code 455, Code 456, Code 457, Code 458, Code 459, Code 460, Code 461, Code 462, Code 463, Code 464, Code 465, Code 466, Code 467, Code 468, Code 469, Code 470, Code 471, Code 472, Code 473, Code 474, Code 475, Code 476, Code 477, Code 478, Code 479, Code 480, Code 481, Code 482, Code 483, Code 484, Code 485, Code 486, Code 487, Code 488, Code 489, Code 490, Code 491, Code 492, Code 493, Code 494, Code 495, Code 496, Code 497, Code 498, Code 499, Code 500, Code 501, Code 502, Code 503, Code 504, Code 505, Code 506, Code 507, Code 508, Code 509, Code 510, Code 511, Code 512, Code 513, Code 514, Code 515, Code 516, Code 517, Code 518, Code 519, Code 520, Code 521, Code 522, Code 523, Code 524, Code 525, Code 526, Code 527, Code 528, Code 529, Code 530, Code 531, Code 532, Code 533, Code 534, Code 535, Code 536, Code 537, Code 538, Code 539, Code 540, Code 541, Code 542, Code 543, Code 544, Code 545, Code 546, Code 547, Code 548, Code 549, Code 550, Code 551, Code 552, Code 553, Code 554, Code 555, Code 556, Code 557, Code 558, Code 559, Code 560, Code 561, Code 562, Code 563, Code 564, Code 565, Code 566, Code 567, Code 568, Code 569, Code 570, Code 571, Code 572, Code 573, Code 574, Code 575, Code 576, Code 577, Code 578, Code 579, Code 580, Code 581, Code 582, Code 583, Code 584, Code 585, Code 586, Code 587, Code 588, Code 589, Code 590, Code 591, Code 592, Code 593, Code 594, Code 595, Code 596, Code 597, Code 598, Code 599, Code 600, Code 601, Code 602, Code 603, Code 604, Code 605, Code 606, Code 607, Code 608, Code 609, Code 610, Code 611, Code 612, Code 613, Code 614, Code 615, Code 616, 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1288, Code 1289, Code 1290, Code 1291, Code 1292, Code 1293, Code 1294, Code 1295, Code 1296, Code 1297, Code 1298, Code 1299, Code 1300, Code 1301, Code 1302, Code 1303, Code 1304, Code 1305, Code 1306, Code 1307, Code 1308, Code 1309, Code 1310, Code 1311, Code 1312, Code 1313, Code 1314, Code 1315, Code 1316, Code 1317, Code 1318, Code 1319, Code 1320, Code 1321, Code 1322, Code 1323, Code 1324, Code 1325, Code 1326, Code 1327, Code 1328, Code 1329, Code 1330, Code 1331, Code 1332, Code 1333, Code 1334, Code 1335, Code 1336, Code 1337, Code 1338, Code 1339, Code 1340, Code 1341, Code 1342, Code 1343, Code 1344, Code 1345, Code 1346, Code 1347, Code 1348, Code 1349, Code 1350, Code 1351, Code 1352, Code 1353, Code 1354, Code 1355, Code 1356, Code 1357, Code 1358, Code 1359, Code 1360, Code 1361, Code 1362, Code 1363, Code 1364, Code 1365, Code 1366, Code 1367, Code 1368, Code 1369, Code 1370, Code 1371, Code 1372, Code 1373, Code 1374, Code 1375, Code 1376, Code 1377, Code 1378, Code 1379, Code 1380, Code 1381, Code 1382, Code 1383, Code 1384, Code 1385, Code 1386, Code 1387, Code 1388, Code 1389, Code 1390, Code 1391, Code 1392, Code 1393, Code 1394, Code 1395, Code 1396, Code 1397, Code 1398, Code 1399, Code 1400, Code 1401, Code 1402, Code 1403, Code 1404, Code 1405, Code 1406, Code 1407, Code 1408, Code 1409, Code 1410, Code 1411, Code 1412, Code 1413, Code 1414, Code 1415, Code 1416, Code 1417, Code 1418, Code 1419, Code 1420, Code 1421, Code 1422, Code 1423, Code 1424, Code 1425, Code 1426, Code 1427, Code 1428, Code 1429, Code 1430, Code 1431, Code 1432, Code 1433, Code 1434, Code 1435, Code 1436, Code 1437, Code 1438, Code 1439, Code 1440, Code 1441, Code 1442, Code 1443, Code 1444, Code 1445, Code 1446, Code 1447, Code 1448, Code 1449, Code 1450, Code 1451, Code 1452, Code 1453, Code 1454, Code 1455, Code 1456, Code 1457, Code 1458, Code 1459, Code 1460, Code 1461, Code 1462, Code 1463, Code 1464, Code 1465, Code 1466, Code 1467, Code 1468, Code



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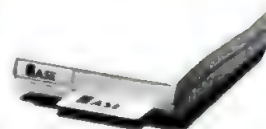
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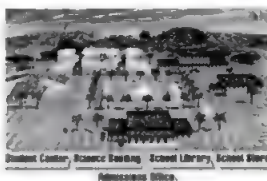
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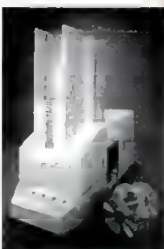
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# After Hours

## Click and Putt

*After 18 holes with these 8 golf games, we had little trouble picking a champion.*

### British Open Championship Golf

**B**ritish Open Championship Golf is a good-looking and generally fun simulation of play at The Old Course at St. Andrews and the Royal Troon golf courses.

The game uses some interesting effects to immerse players in a realistic tournament atmosphere. For example, the outstanding graphics include well-textured buildings, crowds, and all the extras (including a film crew) that you would see at a real golf tournament. The landscape looks great and accurately depicts all of the hazards and environments found on the St. Andrews and Royal Troon courses, right down to the side streets and residential building facades that you'd encounter on the actual courses.

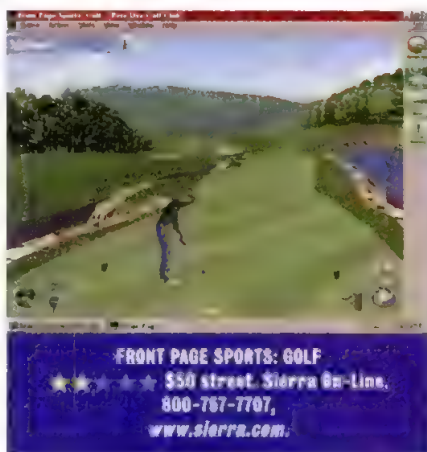
Other realistic touches include a murmuring crowd that responds to the quality of your play; computerized versions of real golfers, including Ian Baker-Finch and Vijay Singh, who can participate in your tournament; and television commentators, including Jim McKay, who give shot-by-shot descriptions of the action.

The game's one major drawback is that it is necessarily limited to the two British

Open courses, which tend to become overly familiar after a while.—*Shane Mooney*

### Front Page Sports: Golf

**S**ierra On-Line's Front Page Sports: Golf has an interesting new gimmick: a dynamic mouse swing. That is, you pull the mouse back to draw back your club, then shove it forward to swing. The speed and accuracy with which you swing governs how far and



straight the shot will go. With the right English on the mouse, you can create some intricate shots. Though the mouse swing is better in this game than in SimGolf (reviewed below), it still leaves too many shots short.

Unfortunately, the mouse swing is the game's primary selling point. Once you get past that, the



rest of Front Page Sports: Golf constitutes a modest golf game that can't stand toe to toe with the competition. The program's graphics are inconsistent, with nice grass textures but flat and pixelized object rendering. The golfer is fully animated but can be inexplicably jerky at times, and he tends to disappear up to his knees on steep hills.

The game comes with three courses and includes Internet play and several scoring modes. Still, Front Page Sports: Golf, despite some innovations, has a long way to go before it can compete with the majors.—*T. Liam McDonald*

### Greg Norman Ultimate Challenge Golf 2.0

**W**hen the first version of Greg Norman Ultimate Challenge Golf was released two years ago, it suffered from a series of flaws: slow load times, a lack of important options, glitchy palettes, jerky golfer animation, and over-

sensitive controls.

Version 2.0 fixes some of these problems, but not to the extent that the game can compete with the others in this story. The graphics, though improved, pale in comparison to the current crop. On the other hand, redraw times are faster, and the game operates fairly well on a midlevel 486-

## INSIDE

### EVIL IS GOOD

Bullfrog's new sim game is pure evil and pure fun. *Page 329.*



### RETURN OF X-COM

It's up to you to thwart the alien invasion of Mega-Primus. *Page 329.*





# After Hours



edit courses from previous versions of Jack Nicklaus.

The game itself has a few problems, such as greens that are difficult to read (despite the slope graph), repetitive and annoying commentary, and slow redraw times on some systems (despite claims on the box of "lightning-fast" and "mercury-like" redraws).

If you like to design your own courses, this is indeed the game for you. But for your basic quick and refreshing round of golf, Jack Nicklaus 4 is only middle-of-the-pack.—*SM and Michael E. Ryan*

## Links LS 1998 Edition



In the realm of computer golf, there is Links and there is everything else. Since its inception, the Links series has set the standard against which all other golf games are measured. Other games may have inventive features such as PGA Tour's pro golfers, Jack

Nicklaus 4's course editor, or Front Page Sports: Golf's mouse swing. But no other golf game has the production values, playability, variety of courses, and sheer beauty of Links LS.

When this series evolved from Links 386 Pro to Links LS, it took the graphics quality and features of computer golfing to a much higher level. Though Links LS 1998 Edition is not a full-engine upgrade, it is a midlevel refinement that adds welcome new features. For starters, the screen redraw times have been significantly enhanced.

Visually, everything seems twice as sharp as in the original Links LS, with enhanced graphics resolutions (up to 1,600-by-1,200 with 16 million colors), sharp new water reflections, and on-screen animations of flags, aircraft, and divots. New views have been added, including a nice wide-angle high shot.

Links offers Internet play for up to eight players and several new scoring modes. Two new golfer animations and



four courses help round out the feature set to make this the premier golf game on the market.—*TLM*

## Microsoft Golf 3.0

If you've never played a computer golf game before and are looking to start, this may be the game for you. Based on an older version of Access Software's Links, Microsoft Golf 3.0 is solid and easy to learn.

Microsoft Golf 3.0's graphics are good, though the play window can only be sized to fill half of the screen. The game gets you started with a helpful, interactive tutorial. And once you're ready to go, you get a video fly-by of each hole.

The game's swing meter is a cinch to use, and you can either let your computerized caddie pick your club and swing style for you or choose them for yourself.

The greens are easy to read, and the slope grid feature makes putting for par a piece of cake. Adding to the experience and the atmosphere of the game are a variety of background noises. These were supposedly recorded from actual courses, but you would never know it, since they sound an awful lot like looping .WAV files.

Microsoft Golf 3.0 includes only two courses but is com-

## Jack Nicklaus 4

Access's Jack Nicklaus 4 is a good game, especially if you're interested in course design.

You have the choice of five different courses and ten different scoring modes, including match play, stroke play, and a \$1 million skins game. The game also includes an Internet-play option.

Jack Nicklaus 4's strongest feature by far, however, is the built-in course-design tool. With this powerful and fairly easy-to-use tool, you can customize and create your own golf courses for use with the game. You can also import and





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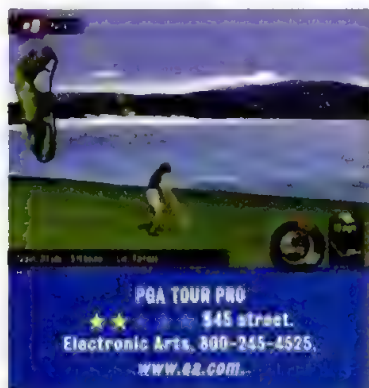
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# After Hours

patible with add-on courses for Links. For those looking to experience the world of computerized golf, Microsoft Golf 3.0 is not the best or flashiest place to play, but it is the best place to start.—SM



## PGA Tour Pro

The PGA Tour series used to be the class act of this genre. Over a dozen tour pros, a true tournament feel, and the

widest variety of camera angles helped make the series popular and tough to beat.

But the latest iteration is a less-than-effective response to the growing competition. In creating PGA Tour Pro, Electronic Arts tried to reinvent the series and lost a good part of its charm in the process. The tour pros and a great tournament mode remain, but the graphics and swing mechanics have gone down the drain.

The graphics, while lush and colorful, are also oddly flat and two-dimensional; distances are particularly hard to gauge. An attempt at animated water backfires badly, with mismatched color palettes and choppy graphics.

The visuals are the least of PGA's problems. Swing control has been completely revamped,

with a clumsy circular powerbar at one side of the control panel. Shot design is difficult because of an automatic club selection that is not only cumbersome and frequently wrong but also mandatory. Despite all this, the chance to golf against pros may lure some players to PGA Tour Pro, though there's not much else to recommend it.—TLM

## SimGolf

After playing a few rounds of this title, we feel that SimFrustration and SimDifficulty would be more appropriate monikers for the game. Learning how to hit a real golf ball with real clubs on a real course isn't nearly as tough as mastering the mechanics of this simulation.

SimGolf is not completely devoid of merit. The included

course designer is pretty good, though not as powerful as the one that comes with Jack Nicklaus 4. The head-to-head modem play and several different scoring modes are welcome features but fail to make up for the game's drawbacks. The graphics in SimGolf are poor, and learning how to swing properly is a real chore.

First you have to line up the club head, using the mouse; then you click on the club head, pull the mouse back, and send it flying forward to drive your ball down the fairway. But if you happen to move your mouse even slightly to either side, you'll shank the ball or else miss it completely.

Overall, SimGolf just isn't very much fun to play, and it shapes up as a weak competitor in this field.—SM



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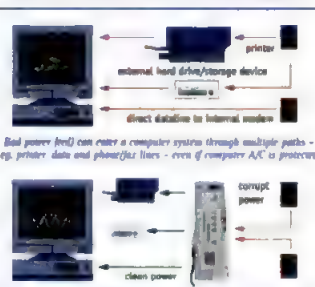
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## SimEvil

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### Dungeon Keeper

In computer gaming lore, a dungeon is typically the home of a nasty, evil villain who has tons of gold. In *Dungeon Keeper*, from Bullfrog and Electronic Arts, you are that nasty, evil villain.

*Dungeon Keeper* requires a Pentium of any speed and 16MB of RAM, though we recommend at least a Pentium/133 with 32MB of RAM. It will run in either Windows 95 or DOS 6.22.

The goal of the game is to build a dungeon and then defend

it against do-gooder heroes who are out for your gold. Just as in Bullfrog's *Theme Hospital*, you build your dungeon by creating a number of rooms, each with a specific purpose. Examples include the treasure room, the training room, the torture chamber, and the graveyard.

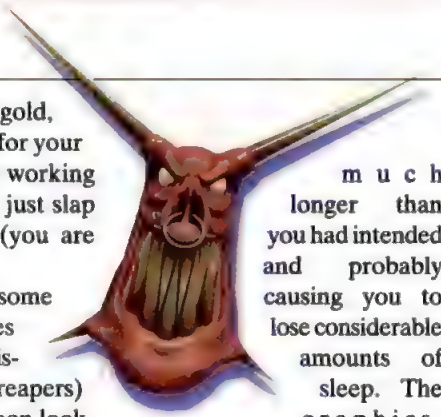
To build these rooms, you need a workforce of imps. These bug-eyed creatures will

tunnel around, mine gold, and claim new areas for your realm. If they're not working fast enough for you, just slap them around a bit (you are evil, after all).

Once you build some rooms, other creatures (bile demons, dark mistresses, and horned reapers) will enter your dungeon looking for work. They'll fight for you, as long as you pay them.

Though gold's in short supply, you'll rarely run out of enemies. Roaming bands of heroes, monsters from other dungeons, and the dreaded Lord of the Land will all make appearances.

*Dungeon Keeper* is one of those rare games that draws you in and keeps you there, playing for



much longer than you had intended and probably causing you to lose considerable amounts of sleep. The graphics, sound, music, and game play are all excellent. Even the artificial intelligence is great; on most levels, it is just tough enough to keep the game challenging and fun.

We did notice that *Dungeon Keeper* slowed to a crawl during some large-scale battles, and we had trouble getting modem play to work on one PC, but neither shortcoming significantly affected our evil doings. In fact, *Dungeon Keeper* is one of the best games we've played all year.—MER



## The Aliens Are Back

*A new look and the ever-popular real-time combat spice up X-COM's latest title.*

### X-COM Apocalypse

*X-COM Apocalypse* may not have the impact of the original *X-COM*, but it's still a great game that manages to hook you and keep you hooked. The original was a huge hit that combined a phased tactical combat system with real-time resource management for a near-perfect mix.

The game runs smoothly on a Pentium/100 with 8MB of RAM and a 4X CD-ROM drive. Though it's a native DOS game, it will launch and run well in Windows 95 with 16MB of RAM.

*X-COM Apocalypse* takes place in a single, sprawling city named Mega-Primus. Various corporations and political

forces are at work in the city and are always in danger of alien infiltration and takeover. You need to keep a lid on the alien threat, or you may find yourself fighting alien-controlled humans, including the police forces.

Spaceships fight UFOs over Mega-Primus in real time, but when aliens are reported inside buildings, you can choose between traditional *X-COM* phased combat and real-time combat. The phased combat is as good as ever, with an improved interface for arming and controlling units. The real-time mode is a bust, however, thanks to poorly implemented artificial intelligence on both sides.

Visually, *Apocalypse* takes some getting used to. Units still disappear behind walls and furniture in this version, a problem that screams for a rotate-view feature (as in *Dungeon Keeper*). Alien graphics are a mixed bag, with many monsters looking just plain ridiculous. Being able to blow up just about any object in the game (walls, furniture,

or buildings) makes up for these failings somewhat.

Overall, *X-COM Apocalypse* has the same addictive qualities as the original. Building and expanding bases, researching new weapons, studying living and dead aliens, and creating tight squads: All of these elements make for superlative game play.—TLM



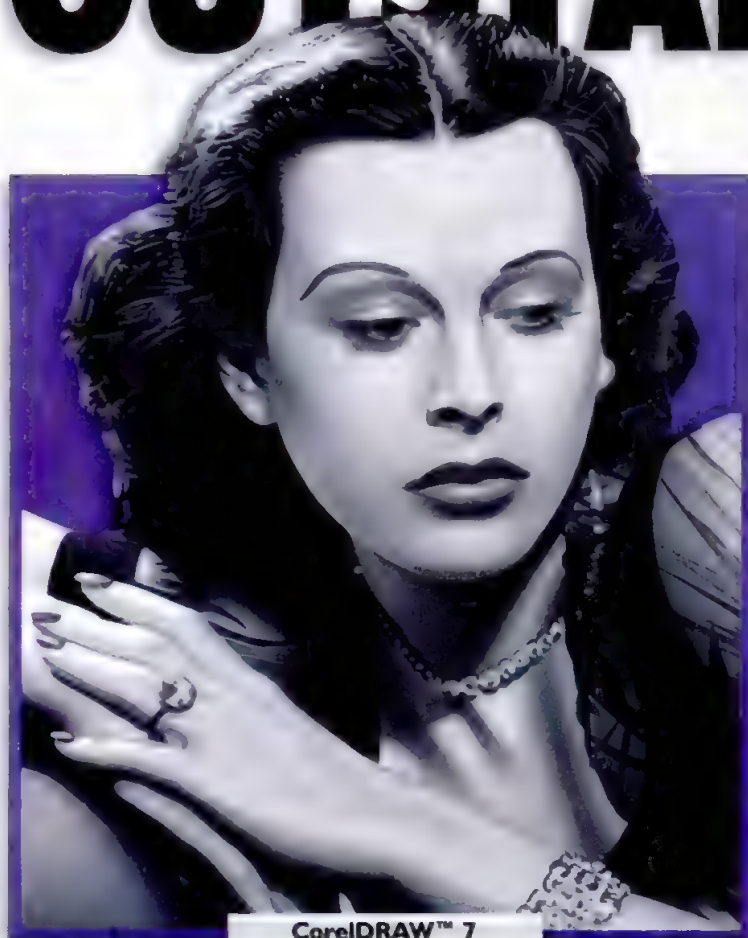


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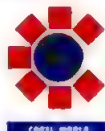


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# Editorial Product Index

| Reader Service No. | Product                                                 | Company                         | Page |
|--------------------|---------------------------------------------------------|---------------------------------|------|
| 402                | Adobe After Effects 3.1 Production Bundle               | Adobe Systems Inc.              | 76   |
| 405                | The AltaVista Network                                   | Digital Equipment Corp.         | 73   |
| 408                | AltaVista Search Personal Extension 97                  | AltaVista Internet Software     | 73   |
| 470                | APC Smart-UPS 2200                                      | American Power Conversion Corp. | 204  |
| 451                | AST Bravo MS 6300                                       | AST Computer                    | 102  |
| 471                | Best Power Fortress LI1420U                             | Best Power                      | 205  |
| 471                | Best Power Fortress LI2KH                               | Best Power                      | 205  |
| 412                | Business Max C6 PR233MMX                                | CyberMax Computer               | 45   |
| 951                | Cisco AS5200 Universal Access Server                    | Cisco Systems                   | NE2  |
|                    | Compaq Professional Workstation 6000                    | Compaq Computer Corp.           | 56   |
| 401                | Corel WordPerfect Suite 8                               | Corel Corp.                     | 60   |
| 411                | CTX LCM233-32CTX                                        | CTX International Inc.          | 45   |
| 491                | Dayna Network Starter Kits                              | Dayna Communications            | 174  |
| 452                | Dell Dimension XPS D300                                 | Dell Computer Corp.             | 108  |
| 452                | Dell WorkStation 400                                    | Dell Computer Corp.             | 116  |
| 472                | Deltec PowerRite Pro II                                 | Deltec Network Systems Group    | 209  |
| 406                | Dimage V                                                | Minolta Corp.                   | 68   |
| 492                | D-Link Network Kit                                      | D-Link Systems                  | 180  |
| 404                | Dragon Naturally Speaking                               | Dragon Systems Inc.             | 64   |
| 472                | Exide NetUPS SE                                         | Exide Electronics Group Inc.    | 209  |
| 955                | Exposé 4.0                                              | Symantec Corp.                  | NE15 |
| 413                | Flex UltraPerformer 233                                 | USA FLex Inc.                   | 45   |
| 952                | Gandalf Xpressway RLAN                                  | Gandalf Technologies Inc.       | NE8  |
| 453                | Gateway G6-300XL                                        | Gateway 2000 Inc.               | 108  |
| 493                | HP Network Kit                                          | Hewlett-Packard Co.             | 185  |
| 457                | IBM IntelliStation M Pro                                | IBM PC Co.                      | 117  |
| 473                | Liebert PowerSure Interactive                           | Liebert Corp.                   | 212  |
| 494                | Linksys Instant Ethernet Series Network Starter Kit     | Linksys Inc.                    | 186  |
| 956                | ManageX 1.0                                             | NuView Inc.                     | NE15 |
| 407                | MDC-FD7 Digital Mavica                                  | Sony Electronics Inc.           | 68   |
| 474                | MGE Pulsar EX20                                         | MGE UPS Systems                 | 214  |
| 953                | Microcom Access Integrator                              | Microcom Inc.                   | NE10 |
| 455                | Micron Millennia XKU 300                                | Micron Electronics Inc.         | 113  |
| 455                | Micron Powerdigm XSU                                    | Micron Electronics Inc.         | 119  |
| 495                | NDC SOHOware Network Personal Starter Kit               | NDC Communications Inc.         | 191  |
| 454                | NEC Direction SPL 300                                   | NEC Computer Systems Division   | 116  |
| 496                | NetGear Network Starter Kit                             | NetGear                         | 191  |
| 957                | NetIQ AppsManager Suite                                 | NetIQ Corp.                     | NE16 |
| 441                | Paint Shop Pro 4.12                                     | JASC Inc.                       | 219  |
| 475                | Para Systems Minuteman XRT 2000                         | Para Systems Inc.               | 216  |
| 410                | Peachtree Complete Accounting Plus Time and Billing 4.0 | Peachtree Software Inc.         | 52   |
| 414                | Polywell Poly C233Mx                                    | Polywell Computer Inc.          | 45   |
| 954                | Shiva LanRover Access Switch                            | Shiva Corp.                     | NE10 |
| 415                | Sys Performance 233M2                                   | Sys Technology Inc.             | 45   |
| 497                | 3Com OfficeConnect Networking Kit                       | 3Com Corp.                      | 195  |
| 476                | Toshiba 1400SE                                          | Toshiba International Corp.     | 217  |
| 477                | Tripp Lite Smart 2200 Net                               | Tripp Lite                      | 217  |
| 403                | Ultimatte                                               | Ultimatte Corp.                 | 76   |

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| Compositing            | Good | Good      |
| Painting               | Good | Good      |
| Output                 | Good | Good      |

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|------------------------|-----------|-----------|
| Editing and retouching | Good      | Excellent |
| Compositing            | Excellent | Excellent |
| Painting               | Good      | Excellent |
| Output                 | Fair      | Good      |

|           |      |      |      |           |
|-----------|------|------|------|-----------|
| Good      | Good | Good | Fair | Fair      |
| Good      | Good | Good | Fair | Excellent |
| Excellent | Good | Fair | Poor | Fair      |
| Fair      | Fair | Fair | Poor | Fair      |
| Good      | Good | Fair | Fair | Good      |
| Fair      | Good | Good | Fair | Good      |
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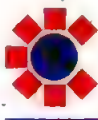
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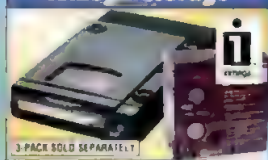
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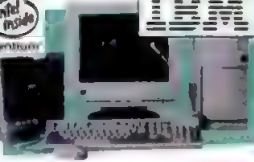
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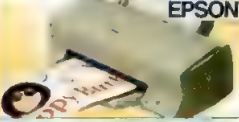
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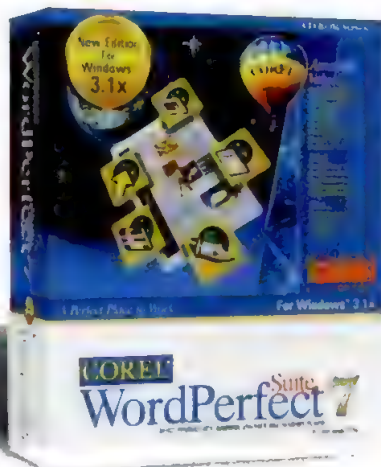
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## Advertisers' Index COMPANIES

| Reader Service No. | Advertiser                         | Page      |
|--------------------|------------------------------------|-----------|
| *                  | A-Frame Software Company .....     | 287-288   |
| 297                | ASP Computer Products .....        | 249       |
| 122                | AST Research .....                 | 22-23     |
| 092                | Acer America .....                 | 206-207 @ |
| *                  | Adaptec .....                      | 320       |
| 079                | Advanced Micro Devices .....       | 128-129   |
| 342                | American Power Conversion .....    | 201-203 @ |
| 341                | American Power Conversion .....    | 325-327 @ |
| *                  | bidnask.com .....                  | 287-288   |
| 297                | Cables to Go .....                 | 249       |
| 292                | Caere Corporation .....            | 8 @       |
| 009                | Cambridge Soundworks .....         | 94 @      |
| *                  | Cloudscape, Inc. ....              | 287-288   |
| *                  | Compaq Computer Corporation .....  | 66-67     |
| *                  | Compaq Computer Corporation .....  | 98-99     |
| *                  | Compaq Computer Corporation .....  | 134-135   |
| *                  | Compaq Computer Corporation .....  | 238-239   |
| *                  | CompUSA Direct .....               | 279       |
| 129                | COMPUTER DISCOUNT WAREHOUSE .....  | 57 @      |
| 109                | COMPUTER DISCOUNT WAREHOUSE .....  | 252-253 @ |
| 159                | COMPUTER DISCOUNT WAREHOUSE .....  | 254-255 @ |
| 318                | COMPUTER DISCOUNT WAREHOUSE .....  | 256 @     |
| *                  | Concurrent CAE Solutions .....     | 287-288   |
| 207                | Corel Corporation .....            | 40-41 @   |
| 332                | Corel Corporation .....            | 144 @     |
| 037                | Corel Corporation .....            | 330 @     |
| 011                | Corel Corporation .....            | 333 @     |
| 041                | Corel Corporation .....            | 338 @     |
| 120                | Crucial Technology .....           | 65 @      |
| 294                | Cyber Media .....                  | 240 @     |
| 343                | Cyril Corporation .....            | 142-143   |
| *                  | Dell Computer Corporation .....    | C5-C8     |
| *                  | Dell Computer Corporation .....    | 54-55     |
| *                  | Dell Computer Corporation .....    | 82-83     |
| *                  | Dell Computer Corporation .....    | 146-147   |
| *                  | Dell Computer Corporation .....    | 267       |
| *                  | Digital Equipment Corp. ....       | 58-59     |
| 283                | Dirt Cheap Drives .....            | 283 @     |
| 004                | Epson America .....                | 12-13 @   |
| 005                | Epson America .....                | 204-205 @ |
| 272                | First Source International .....   | 286 @     |
| *                  | Gateway 2000 .....                 | 36A-37    |
| *                  | Gateway 2000 .....                 | 157-164   |
| 126                | Hayes Microcomputer Products ..... | 328 @     |
| *                  | Hewlett Packard .....              | 86        |

| Reader Service No. | Advertiser                              | Page      |
|--------------------|-----------------------------------------|-----------|
| *                  | Hewlett Packard .....                   | 171       |
| *                  | Hewlett Packard .....                   | 173       |
| *                  | Hewlett Packard .....                   | 175       |
| *                  | Hewlett Packard .....                   | 177-179   |
| *                  | Hewlett Packard .....                   | 141       |
| 143                | Hitachi PC Corporation .....            | 62-63 @   |
| *                  | IBM Corporation .....                   | 20        |
| *                  | IBM Corporation .....                   | 114-115   |
| *                  | IBM Corporation .....                   | 117       |
| *                  | ISC Consultants, Inc. ....              | 287-288   |
| *                  | Imation .....                           | 196       |
| 278                | Insight Direct .....                    | 280-281 @ |
| *                  | Intel Corporation .....                 | 74-75     |
| *                  | Intel Corporation .....                 | 90-91     |
| *                  | InterSoft Argentina S.A. ....           | 287-288   |
| 295                | J&R Music World .....                   | 334-337 @ |
| *                  | KeyLabs Inc. ....                       | 287-288   |
| 106                | Kingston Technology .....               | 237 @     |
| 019                | L.A. Trade .....                        | 273       |
| *                  | Leap Frog Lab .....                     | 270-271   |
| 039                | Mag InnoVision .....                    | 18-19 @   |
| 381                | Matrox Graphics Inc. ....               | 127 @     |
| 855                | Micro Solutions Computer Products ..... | 262 @     |
| 003                | Micro Warehouse .....                   | 260-261 @ |
| *                  | Micrografx .....                        | 69        |
| 203                | Micron Electronics .....                | 15 @      |
| 119                | Micron Electronics .....                | 16-17 @   |
| 013                | Micron Electronics .....                | 48A-J     |
| *                  | Microsoft .....                         | C2-C4, p1 |
| 012                | Mindscape .....                         | 324       |
| 089                | Mindspring .....                        | 244 @     |
| 340                | Minolta .....                           | 151       |
| 036                | Mitac International .....               | 226       |
| 107                | NEC Technologies .....                  | 2-3       |
| 156                | NEC Technologies .....                  | 31-34     |
| 155                | NEC Technologies .....                  | 50-51     |
| 154                | NEC Technologies .....                  | 187-190   |
| 157                | NEC Technologies .....                  | 210-211   |
| 153                | NEC Technologies .....                  | 224       |
| *                  | NetFactory, Inc. ....                   | 287-288   |
| 268                | Nikon .....                             | 14 @      |
| *                  | Novell, Inc. ....                       | 26-27     |
| 118                | Optique .....                           | 218 @     |
| 298                | Optique .....                           | 331 @     |
| *                  | Oracle Corp. ....                       | 11        |

| Reader Service No. | Advertiser                           | Page      |
|--------------------|--------------------------------------|-----------|
| 047                | PC Connection .....                  | 268-269   |
| 330                | PC Mall .....                        | 264-265   |
| 080                | PC Power and Cooling .....           | 88 @      |
| 068                | PC Zone .....                        | 274 @     |
| 020                | PK Electronics .....                 | 213       |
| 022                | PK Electronics .....                 | 215       |
| *                  | PCs Compleat .....                   | 279       |
| 014                | Paragon .....                        | 272 @     |
| *                  | Paralogic Corporation .....          | 287-288   |
| 015                | Philips Electronics .....            | 166       |
| 021                | Phillips Business Electronics .....  | 223       |
| 193                | Play Inc. ....                       | 323 @     |
| 348                | Premio Computers, Inc. ....          | 53 @      |
| 287                | ProGen Systems .....                 | 118 @     |
| *                  | ProtoView Development .....          | 287-288   |
| 074                | Quantex .....                        | 153-155   |
| *                  | Recital Corp. ....                   | 287-288   |
| 205                | Ricoh Corporation .....              | 92 @      |
| 309                | S.A.G./Storage Solutions .....       | 78-79 @   |
| *                  | SPSS, Inc. ....                      | 257       |
| 169                | SafeGuard Interactive .....          | 246 @     |
| 352                | Softbank Expos .....                 | 96        |
| 057                | Statsoft .....                       | 43 @      |
| 335                | Sun Microsystems .....               | 5 @       |
| 349                | Tatung .....                         | 44        |
| *                  | Tektronix Inc. ....                  | 194       |
| 066                | TigerDirect .....                    | 343 @     |
| 377                | Toshiba America .....                | 120-121   |
| 242                | UMAX Technology .....                | 70-72     |
| 055                | Unicent .....                        | 181-183   |
| 008                | Unisys Corporation .....             | 106-107 @ |
| 006                | Unisys Corporation .....             | 119 @     |
| *                  | US Robotics Inc. ....                | 109-112   |
| 051                | USA Flex .....                       | 282 @     |
| *                  | USR Mobile Communications Corp. .... | 131       |
| *                  | USR Mobile Communications Corp. .... | 133       |
| 117                | ViewSonic .....                      | 84 @      |
| *                  | Visio .....                          | 80        |
| *                  | WebMan Technologies, Inc. ....       | 287-288   |
| *                  | WiGiTek Corporation .....            | 287-288   |
| 085                | Winbook .....                        | 77 @      |
| *                  | Xircom .....                         | 25        |
| *                  | ZD Net .....                         | 97        |
| *                  | ZD Netbuyer .....                    | 250       |

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## Advertisers' Index PRODUCTS

| Reader Service No.           | Company                         | Product                          | Page    |
|------------------------------|---------------------------------|----------------------------------|---------|
| <b>100% PURE JAVA</b>        |                                 |                                  |         |
| *                            | A-Frame Software Company        | Java Products                    | 287-288 |
| *                            | bednask.com                     | Java Products                    | 287-288 |
| *                            | Cloudscape, Inc.                | Java Products                    | 287-288 |
| *                            | Concurrent CAE Solutions        | Java Products                    | 287-288 |
| *                            | ISC Consultants                 | Java Products                    | 287-288 |
| *                            | InterSoft Argentina S.A.        | Java Products                    | 287-288 |
| *                            | KeyLabs Inc.                    | Java Products                    | 287-288 |
| *                            | NetFactory, Inc.                | Java Products                    | 287-288 |
| *                            | Paralogic Corporation           | Java Products                    | 287-288 |
| *                            | ProtoView Development           | Java Products                    | 287-288 |
| *                            | Recital Corp.                   | Java Products                    | 287-288 |
| *                            | WebMan Technologies, Inc.       | Java Products                    | 287-288 |
| *                            | WiGiTek Corporation             | Java Products                    | 287-288 |
| <b>ACCELERATOR BOARDS</b>    |                                 |                                  |         |
| *                            | Imation                         | Travan DT                        | 196     |
| *                            | Intel Corporation               | Pentium 2                        | 90-91   |
| *                            | USR Mobile Communications Corp. | Modem Card                       | 131     |
| *                            | USR Mobile Communications Corp. | Accelerator Boards               | 133     |
| <b>ADD-ON BOARDS</b>         |                                 |                                  |         |
| 381                          | Matrox Graphics Inc.            | Millennium I                     | 127     |
| <b>BACKUP SOFTWARE</b>       |                                 |                                  |         |
| 342                          | American Power Conversion       | Smart-UPS                        | 201-203 |
| 341                          | American Power Conversion       | Back-UPS Office                  | 325-327 |
| 015                          | Philips Electronics             | CD Rewritable Drive              | 166     |
| 169                          | SafeGuard Interactive           | BACKUP                           | 246     |
| <b>CD-ROM</b>                |                                 |                                  |         |
| *                            | Adaptec                         | Adaptec CD-R                     | 320     |
| 015                          | Philips Electronics             | CD Rewritable Drive              | 166     |
| <b>CHIPS/PROCESSORS</b>      |                                 |                                  |         |
| 079                          | Advanced Micro Devices          | K6 Microprocessor                | 128-129 |
| 343                          | Cyrix Corporation               | Chips                            | 142-143 |
| *                            | Intel Corporation               | Computer Enhancement Group       | 74-75   |
| 106                          | Kingston Technology             | Memory                           | 237     |
| <b>COMPUTERS/COMPATIBLES</b> |                                 |                                  |         |
| *                            | Compaq Computer Corporation     | Desktop                          | 134-135 |
| *                            | Compaq Computer Corporation     | Servers                          | 66-67   |
| *                            | Compaq Computer Corporation     | Compaq Branding                  | 98-99   |
| *                            | CompUSA Direct                  | Mail Order                       | 275-277 |
| 109                          | COMPUTER DISCOUNT WAREHOUSE     | Hardware                         | 252-253 |
| 159                          | COMPUTER DISCOUNT WAREHOUSE     | Hardware                         | 254-255 |
| 318                          | COMPUTER DISCOUNT WAREHOUSE     | Hardware                         | 256     |
| 129                          | COMPUTER DISCOUNT WAREHOUSE     | Hardware                         | 57      |
| *                            | Dell Computer Corporation       | Notebooks/PCs                    | C5-C8   |
| *                            | Dell Computer Corporation       | Latitude                         | 146-147 |
| *                            | Dell Computer Corporation       | Dimension and Latitude           | 267     |
| *                            | Dell Computer Corporation       | Workstation                      | 54-55   |
| *                            | Dell Computer Corporation       | Dimension                        | 82-83   |
| *                            | Digital Equipment Corp.         | Alpha PC's                       | 58-59   |
| 272                          | First Source International      | Memory, Notebooks, Peripherals   | 286     |
| *                            | Gateway 2000                    | PCs                              | 157-164 |
| *                            | Hewlett Packard                 | NetServers                       | 171     |
| *                            | Hewlett Packard                 | Desktop PCs                      | 175     |
| 143                          | Hitachi PC Corporation          | Hitachi VisionBook Pro Notebooks | 62-63   |
| 295                          | J&R Music World                 | Systems, Hardware, Peripherals   | 334-337 |
| *                            | Leap Frog Lab                   | PCs/Notebooks/Upgrades           | 270-271 |
| 003                          | Micro Warehouse                 | Hardware, Software, Systems      | 260-261 |
| 203                          | Micron Electronics              | Service and Support              | 15      |
| 119                          | Micron Electronics              | Vetix LXI, MXI, Clientpro        | 16-17   |
| 013                          | Micron Electronics              | Micron Family of Products        | 48A-J   |
| 012                          | Mindscape                       | Mavis Typing Computer            | 324     |
| 154                          | NEC Technologies                | NEC NOW                          | 187-190 |
| 107                          | NEC Technologies                | NEC NOW                          | 2-3     |
| 156                          | NEC Technologies                | NEC NOW                          | 31-34   |
| 047                          | PC Connection                   | PCs, Peripherals, Software       | 268-269 |
| 068                          | PC Zone                         | Mail Order                       | 274     |
| *                            | PCs Complete                    | Mail Order                       | 275-277 |
| 348                          | Premio Computers, Inc.          | PCs                              | 53      |
| 077                          | ProGen Systems                  | Desktop Computers                | 118     |
| 074                          | Quantex                         | Quantex Systems                  | 153-155 |
| 009                          | S.A.G./Storage Solutions        | Servers and Storage              | 78-79   |
| 349                          | Tatung                          | Tatung TNB-5600 Notebooks        | 44      |
| 066                          | TigerDirect                     | Hardware, Software, Peripherals  | 343     |
| 377                          | Toshiba America                 | Notebook Computers               | 120-121 |
| 051                          | USA Flex                        | Notebooks, Desktops, Peripherals | 282     |
| 242                          | UMAX Technology                 | Computers/Compatible             | 70-72   |
| 055                          | Unicent                         | Systems, Mail Order              | 181-183 |
| 008                          | Unisys Corporation              | Unisys Servers                   | 106-107 |
| 006                          | Unisys Corporation              | Unisys Servers                   | 119     |
| 085                          | Winbook                         | XP5 Pro and FX Notebooks         | 77      |
| <b>DATA BASE MANAGERS</b>    |                                 |                                  |         |
| *                            | Oracle Corp.                    | Oracle InterOffice               | 11      |
| <b>DATA CARTRIDGES</b>       |                                 |                                  |         |
| 014                          | Paragon                         | Infinity                         | 272     |
| <b>DESK TOP PUBLISHING</b>   |                                 |                                  |         |
| *                            | Micrografix                     | Flowchart 7                      | 69      |

| Reader Service No.                   | Company                           | Product                          | Page    |
|--------------------------------------|-----------------------------------|----------------------------------|---------|
| <b>DIAGNOSTIC SOFTWARE</b>           |                                   |                                  |         |
| 294                                  | Cyber Media                       | First Aid                        | 240     |
| <b>DISK BACKUP &amp; TAPE DRIVES</b> |                                   |                                  |         |
| 855                                  | Micro Solutions Computer Products | Backpack Bantam                  | 262     |
| 014                                  | Paragon                           | Infinity                         | 272     |
| 015                                  | Philips Electronics               | CD Rewritable Drive              | 166     |
| <b>DISPLAY PANELS/PROJECTORS</b>     |                                   |                                  |         |
| 005                                  | Epson America                     | Epson Projectors                 | 204-205 |
| 157                                  | NEC Technologies                  | NEC LCD Monitor Display          | 210-211 |
| <b>EDUCATIONAL SOFTWARE</b>          |                                   |                                  |         |
| 332                                  | Corel Corporation                 | WordPerfect Suite 8              | 144     |
| 037                                  | Corel Corporation                 | Draw 7                           | 330     |
| 011                                  | Corel Corporation                 | Photo-Paint 7                    | 333     |
| 041                                  | Corel Corporation                 | WordPerfect Suite 7              | 338     |
| 207                                  | Corel Corporation                 | Pro/Netscape Communicator        | 40-41   |
| <b>ENTERTAINMENT SOFTWARE</b>        |                                   |                                  |         |
| 332                                  | Corel Corporation                 | WordPerfect Suite 8              | 144     |
| 037                                  | Corel Corporation                 | Draw 7                           | 330     |
| 011                                  | Corel Corporation                 | Photo-Paint 7                    | 333     |
| 041                                  | Corel Corporation                 | WordPerfect Suite 7              | 338     |
| 207                                  | Corel Corporation                 | Pro/Netscape Communicator        | 40-41   |
| <b>FLOWCHARTING SOFTWARE</b>         |                                   |                                  |         |
| *                                    | Micrografix                       | Flowchart 7                      | 69      |
| *                                    | Visio                             | Visio                            | 80      |
| <b>GRAPHICAL INTERFACE</b>           |                                   |                                  |         |
| 381                                  | Matrox Graphics Inc.              | Millennium I                     | 127     |
| <b>GRAPHICS SOFTWARE</b>             |                                   |                                  |         |
| 292                                  | Caere Corporation                 | OmniPage Pro                     | 8       |
| 332                                  | Corel Corporation                 | WordPerfect Suite 8              | 144     |
| 207                                  | Corel Corporation                 | Pro/Netscape Communicator        | 40-41   |
| *                                    | Micrografix                       | Flowchart 7                      | 69      |
| *                                    | Visio                             | Visio                            | 80      |
| <b>GRAPHICS SOFTWARE</b>             |                                   |                                  |         |
| 037                                  | Corel Corporation                 | Draw 7                           | 330     |
| 011                                  | Corel Corporation                 | Photo-Paint 7                    | 333     |
| 041                                  | Corel Corporation                 | WordPerfect Suite 7              | 338     |
| <b>HAND-HELD PC'S</b>                |                                   |                                  |         |
| *                                    | Hewlett Packard                   | Palmtops                         | 177     |
| <b>HARD DRIVES</b>                   |                                   |                                  |         |
| 283                                  | Dirt Cheap Drives                 | Mass Storage                     | 283     |
| 019                                  | L.A. Trade                        | Memory, Hard Drives, PCMCIA      | 273     |
| 014                                  | Paragon                           | Infinity                         | 272     |
| <b>HARDWARE</b>                      |                                   |                                  |         |
| *                                    | Adaptec                           | Adaptec CD-R                     | 320     |
| *                                    | Compaq Computer Corporation       | Desktop                          | 134-135 |
| *                                    | Compaq Computer Corporation       | Compaq Solutions                 | 238-239 |
| *                                    | Compaq Computer Corporation       | Servers                          | 66-67   |
| *                                    | Compaq Computer Corporation       | Compaq Branding                  | 98-99   |
| *                                    | CompUSA Direct                    | Mail Order                       | 278-279 |
| 120                                  | Crucial Technology                | Micron Memory Upgrades           | 65      |
| *                                    | Dell Computer Corporation         | Notebooks/PCs                    | C5-C8   |
| *                                    | Dell Computer Corporation         | Latitude                         | 146-147 |
| *                                    | Dell Computer Corporation         | Dimension and Latitude           | 267     |
| *                                    | Dell Computer Corporation         | Dimension                        | 82-83   |
| *                                    | Digital Equipment Corp.           | Alpha PC's                       | 58-59   |
| 283                                  | Dirt Cheap Drives                 | Mass Storage                     | 283     |
| 126                                  | Hayes Microcomputer Products      | Hayes 56K Modem                  | 328     |
| 143                                  | Hitachi PC Corporation            | Hitachi VisionBook Pro Notebooks | 62-63   |
| *                                    | Imation                           | Travan DT                        | 196     |
| *                                    | Intel Corporation                 | Computer Enhancement Group       | 74-75   |
| *                                    | Intel Corporation                 | Pentium 2                        | 90-91   |
| 295                                  | J&R Music World                   | Systems, Hardware, Peripherals   | 334-337 |
| 106                                  | Kingston Technology               | Memory                           | 237     |
| *                                    | Leap Frog Lab                     | PCs/Notebooks/Upgrades           | 270-271 |
| 039                                  | Mag InnoVision                    | MAG InnoVision Monitors          | 18-19   |
| 003                                  | Micro Warehouse                   | Hardware, Software, Systems      | 260-261 |
| 119                                  | Micron Electronics                | Vetix LXI, MXI, Clientpro        | 16-17   |
| 013                                  | Micron Electronics                | Micron Family of Products        | 48A-J   |
| 036                                  | Mitac International               | Mitac 5027                       | 226     |
| 118                                  | Optique                           | Optique V95 19" Monitor          | 218     |
| 298                                  | Optique                           | Opti-UPS                         | 331     |
| 330                                  | PC Mail                           | Hardware, Software, Peripherals  | 264-265 |
| 080                                  | PC Power and Cooling              | Power Protection/Cooling Devices | 88      |
| 068                                  | PC Zone                           | Mail Order                       | 274     |
| *                                    | PCs Complete                      | Mail Order                       | 275-277 |
| 014                                  | Paragon                           | Infinity                         | 272     |
| 348                                  | Premio Computers, Inc.            | PCs                              | 53      |
| 074                                  | Quantex                           | Quantex Systems                  | 153-155 |
| 205                                  | Ricoh Corporation                 | Ricoh Aficio Color Copiers       | 92      |
| 309                                  | S.A.G./Storage Solutions          | Servers and Storage              | 78-79   |
| 349                                  | Tatung                            | Tatung TNB-5600 Notebooks        | 44      |
| *                                    | Tektronix Inc.                    | Graphic Printing and Imaging     | 194     |
| 066                                  | TigerDirect                       | Hardware, Software, Peripherals  | 343     |
| 377                                  | Toshiba America                   | Notebook Computers               | 120-121 |



## Advertisers' Index PRODUCTS

### Reader Service

| No. | Company            | Product              | Page    |
|-----|--------------------|----------------------|---------|
| 242 | UMAX Technology    | Computers/Compatible | 70-72   |
| 008 | Unisys Corporation | Unisys Servers       | 106-107 |
| 008 | Unisys Corporation | Unisys Servers       | 119     |
| 117 | ViewSonic          | ViewSonic Monitor    | 84      |

#### HUBS

|   |                   |                            |       |
|---|-------------------|----------------------------|-------|
| * | Intel Corporation | Computer Enhancement Group | 74-75 |
|---|-------------------|----------------------------|-------|

#### INTERNET

|     |                       |                 |     |
|-----|-----------------------|-----------------|-----|
| 297 | ASP Computer Products | EZ MAIL         | 249 |
| 297 | Cables to Go          | EZ MAIL         | 249 |
| 089 | Mindspring            | Internet Access | 244 |
| 169 | SafeGuard Interactive | BACKUP          | 246 |
| *   | ZD Net                | CompuServe      | 97  |

#### KEYBOARDS

|   |                             |                  |         |
|---|-----------------------------|------------------|---------|
| * | Compaq Computer Corporation | Compaq Solutions | 238-239 |
|---|-----------------------------|------------------|---------|

#### LABEL/FORM SOFTWARE

|     |                   |              |   |
|-----|-------------------|--------------|---|
| 292 | Caere Corporation | OmniPage Pro | 8 |
|-----|-------------------|--------------|---|

#### LAN ADAPTER BOARDS

|   |                   |                            |       |
|---|-------------------|----------------------------|-------|
| * | Intel Corporation | Computer Enhancement Group | 74-75 |
| * | Xircom            | Ethernet                   | 25    |

#### LAPTOP/PORTABLE COMPUTERS

|     |                             |                                         |         |
|-----|-----------------------------|-----------------------------------------|---------|
| 092 | Acer America                | Mobile Client Server                    | 206-207 |
| *   | Compaq Computer Corporation | Desktop                                 | 134-135 |
| *   | Compaq Computer Corporation | Compaq Solutions                        | 238-239 |
| *   | Compaq Computer Corporation | Servers                                 | 66-67   |
| *   | Compaq Computer Corporation | Compaq Branding                         | 98-99   |
| *   | CompUSA Direct              | Mail Order                              | 275-279 |
| 109 | COMPUTER DISCOUNT WAREHOUSE | Laptops                                 | 252-253 |
| 159 | COMPUTER DISCOUNT WAREHOUSE | Laptops                                 | 254-255 |
| 318 | COMPUTER DISCOUNT WAREHOUSE | Laptops                                 | 256     |
| 129 | COMPUTER DISCOUNT WAREHOUSE | Laptops                                 | 57      |
| *   | Dell Computer Corporation   | Latitude                                | 146-147 |
| *   | Dell Computer Corporation   | Dimension and Latitude                  | 267     |
| 272 | First Source International  | Memory, Notebooks, Peripherals          | 286     |
| *   | Gateway 2000                | Notebooks                               | 157-164 |
| *   | Gateway 2000                | Notebooks, PCs, Mail Order, Peripherals | 36A-37  |
| *   | Hewlett Packard             | Notebook Computers                      | 173     |
| 143 | Hitachi PC Corporation      | Hitachi VisionBook Pro Notebooks        | 62-63   |
| 295 | J&R Music World             | Systems, Hardware, Peripherals          | 334-337 |
| 003 | Micro Warehouse             | Hardware, Software, Systems             | 260-261 |
| 119 | Micron Electronics          | Vetix LXI, MXI, Clientpro               | 16-17   |
| 013 | Micron Electronics          | Micron Family of Products               | 46A-J   |
| 036 | Mitac International         | Mitac 5027                              | 226     |
| 068 | PC Zone                     | Mail Order                              | 274     |
| *   | PCs Complete                | Mail Order                              | 275-277 |
| 349 | Tatung                      | Tatung TNB-5600 Notebooks               | 44      |
| 377 | Toshiba America             | Notebook Computers                      | 120-121 |
| 051 | USA Flex                    | Notebooks, Desktops, Peripherals        | 282     |
| 008 | Unisys Corporation          | Unisys Servers                          | 106-107 |
| 006 | Unisys Corporation          | Unisys Servers                          | 119     |
| 085 | Winbook                     | XPS Pro and FX Notebooks                | 77      |

#### LOCAL AREA NETWORKING

|     |                             |                            |         |
|-----|-----------------------------|----------------------------|---------|
| 109 | COMPUTER DISCOUNT WAREHOUSE | Networking Products        | 252-253 |
| 159 | COMPUTER DISCOUNT WAREHOUSE | Networking Products        | 254-255 |
| 318 | COMPUTER DISCOUNT WAREHOUSE | Networking Products        | 256     |
| 129 | COMPUTER DISCOUNT WAREHOUSE | Networking Products        | 57      |
| *   | Intel Corporation           | Computer Enhancement Group | 74-75   |
| *   | Novell, Inc.                | NDS                        | 26-27   |

#### MAIL ORDER

|     |                             |                                         |         |
|-----|-----------------------------|-----------------------------------------|---------|
| *   | CompUSA Direct              | Mail Order                              | 275-279 |
| 109 | COMPUTER DISCOUNT WAREHOUSE | Reseller                                | 252-253 |
| 159 | COMPUTER DISCOUNT WAREHOUSE | Reseller                                | 254-255 |
| 318 | COMPUTER DISCOUNT WAREHOUSE | Reseller                                | 256     |
| 129 | COMPUTER DISCOUNT WAREHOUSE | Reseller                                | 57      |
| 283 | Dirt Cheap Drives           | Mass Storage                            | 283     |
| 272 | First Source International  | Memory, Notebooks, Peripherals          | 286     |
| *   | Gateway 2000                | Mail Order                              | 157-164 |
| *   | Gateway 2000                | Notebooks, PCs, Mail Order, Peripherals | 36A-37  |
| 278 | Insight Direct              | Insight Mail Order                      | 280-281 |
| 295 | J&R Music World             | Systems, Hardware, Peripherals          | 334-337 |
| 019 | L.A. Trade                  | Memory, Hard Drives, PCMCIA             | 273     |
| 047 | PC Connection               | PCs, Peripherals, Software              | 268-269 |
| 330 | PC Mail                     | Hardware, Software, Peripherals         | 264-265 |
| 068 | PC Zone                     | Mail Order                              | 274     |
| *   | PCs Complete                | Mail Order                              | 275-277 |
| 074 | Quantex                     | Quantex Systems                         | 153-155 |
| 068 | TigerDirect                 | Hardware, Software, Peripherals         | 343     |
| 051 | USA Flex                    | Notebooks, Desktops, Peripherals        | 282     |
| 055 | Unicent                     | Systems, Mail Order                     | 181-183 |
| 085 | Winbook                     | XPS Pro and FX Notebooks                | 77      |

#### MASS STORAGE

|     |                                   |                     |       |
|-----|-----------------------------------|---------------------|-------|
| 283 | Dirt Cheap Drives                 | Mass Storage        | 283   |
| *   | Imation                           | Travan DT           | 196   |
| 855 | Micro Solutions Computer Products | Backpack Bantam     | 262   |
| 309 | S.A.G./Storage Solutions          | Servers and Storage | 78-79 |
| 169 | SafeGuard Interactive             | BACKUP              | 246   |

### Reader Service

| No.           | Company                    | Product                        | Page |
|---------------|----------------------------|--------------------------------|------|
| <b>MEMORY</b> |                            |                                |      |
| 120           | Crucial Technology         | Micron Memory Upgrades         | 65   |
| 272           | First Source International | Memory, Notebooks, Peripherals | 286  |
| 106           | Kingston Technology        | Memory                         | 237  |
| 019           | L.A. Trade                 | Memory, Hard Drives, PCMCIA    | 273  |

#### MISCELLANEOUS

|     |                   |                                 |         |
|-----|-------------------|---------------------------------|---------|
| *   | IBM Corporation   | Small/Medium Business Solutions | 114-115 |
| *   | IBM Corporation   | IBM Corporate Channel           | 117     |
| 193 | Play Inc.         | Snappy                          | 323     |
| 205 | Ricoh Corporation | Ricoh Aficio Color Copiers      | 92      |
| 352 | Softbank Expos    | Network & Interop               | 96      |

#### MODEMS

|     |                                 |                    |         |
|-----|---------------------------------|--------------------|---------|
| 126 | Hayes Microcomputer Products    | Hayes 56K Modem    | 328     |
| *   | US Robotics Inc.                | X2                 | 109-112 |
| *   | USR Mobile Communications Corp. | Modem Card         | 131     |
| *   | USR Mobile Communications Corp. | Accelerator Boards | 133     |

#### MONITORS

|     |                               |                         |       |
|-----|-------------------------------|-------------------------|-------|
| 039 | Mag InnoVision                | MAG InnoVision Monitors | 18-19 |
| 155 | NEC Technologies              | A&E Monitors            | 50-51 |
| 118 | Optique                       | Optique V95 19" Monitor | 218   |
| 021 | Phillips Business Electronics | Monitors                | 223   |
| 117 | ViewSonic                     | ViewSonic Monitor       | 84    |

#### MULTIMEDIA HARDWARE

|     |                                   |                 |         |
|-----|-----------------------------------|-----------------|---------|
| 009 | Cambridge Soundworks              | PC Works        | 94      |
| *   | CompUSA Direct                    | Mail Order      | 275-279 |
| 855 | Micro Solutions Computer Products | Backpack Bantam | 262     |
| *   | PCs Complete                      | Mail Order      | 275-277 |

#### MULTIMEDIA SOFTWARE

|     |                   |                           |       |
|-----|-------------------|---------------------------|-------|
| 332 | Corel Corporation | WordPerfect Suite 8       | 144   |
| 037 | Corel Corporation | Draw 7                    | 330   |
| 011 | Corel Corporation | Photo-Paint 7             | 333   |
| 041 | Corel Corporation | WordPerfect Suite 7       | 338   |
| 207 | Corel Corporation | Pro/Netscape Communicator | 40-41 |
| *   | Micrografix       | Flowcharter 7             | 69    |

#### NETWORK INTERFACE CARDS

|   |        |          |    |
|---|--------|----------|----|
| * | Xircom | Ethernet | 25 |
|---|--------|----------|----|

#### NETWORKING SOFTWARE

|   |                           |                    |       |
|---|---------------------------|--------------------|-------|
| * | Dell Computer Corporation | Workstation        | 54-55 |
| * | Novell, Inc.              | NDS                | 26-27 |
| * | Oracle Corp.              | Oracle InterOffice | 11    |

#### OCR SOFTWARE

|     |                   |              |   |
|-----|-------------------|--------------|---|
| 292 | Caere Corporation | OmniPage Pro | 8 |
|-----|-------------------|--------------|---|

#### ON LINE SERVICES

|   |             |            |     |
|---|-------------|------------|-----|
| * | ZD Net      | CompuServe | 97  |
| * | ZD Netbuyer | NetBuyer   | 250 |

#### ORGANIZATIONAL SOFTWARE

|   |           |                     |       |
|---|-----------|---------------------|-------|
| * | Microsoft | Microsoft Office 97 | C2-C4 |
| * | Microsoft | Microsoft Office 97 | 1     |
| * | Visio     | Visio               | 80    |

#### PC DIRECT

|     |                                   |                                 |         |
|-----|-----------------------------------|---------------------------------|---------|
| *   | CompUSA Direct                    | Mail Order                      | 275-279 |
| 109 | COMPUTER DISCOUNT WAREHOUSE       | Reseller                        | 252-253 |
| 159 | COMPUTER DISCOUNT WAREHOUSE       | Reseller                        | 254-255 |
| 318 | COMPUTER DISCOUNT WAREHOUSE       | Reseller                        | 256     |
| 283 | Dirt Cheap Drives                 | Mass Storage                    | 283     |
| 272 | First Source International        | Memory, Notebooks, Peripherals  | 286     |
| 278 | Insight Direct                    | Insight Mail Order              | 280-281 |
| 019 | L.A. Trade                        | Memory, Hard Drives, PCMCIA     | 273     |
| *   | Leap Frog Lab                     | PCs/Notebooks/Upgrades          | 270-271 |
| 855 | Micro Solutions Computer Products | Backpack Bantam                 | 262     |
| 003 | Micro Warehouse                   | Hardware, Software, Systems     | 260-261 |
| 047 | PC Connection                     | PCs, Peripherals, Software      | 268-269 |
| 330 | PC Mail                           | Hardware, Software, Peripherals | 264-265 |
| 068 | PC Zone                           | Mail Order                      | 274     |
| *   | PCs Complete                      | Mail Order                      | 275-277 |
| 014 | Paragon                           | Infinity                        | 272     |
| *   | SPSS, Inc.                        | SPSS 7.5 for Windows            | 257     |
| 051 | USA Flex                          | Printers                        | 282     |

#### PCMCIA

|     |                  |                             |         |
|-----|------------------|-----------------------------|---------|
| 019 | L.A. Trade       | Memory, Hard Drives, PCMCIA | 273     |
| *   | US Robotics Inc. | X2                          | 109-112 |
| *   | Xircom           | Ethernet                    | 25      |

#### PERIPHERALS

|     |                              |                                         |         |
|-----|------------------------------|-----------------------------------------|---------|
| 004 | Epson America                | Epson Printer                           | 12-13   |
| 272 | First Source International   | Memory, Notebooks, Peripherals          | 286     |
| *   | Gateway 2000                 | Peripherals                             | 157-164 |
| *   | Gateway 2000                 | Notebooks, PCs, Mail Order, Peripherals | 36A-37  |
| 126 | Hayes Microcomputer Products | Hayes 56K Modem                         | 328     |
| *   | Imation                      | Travan DT                               | 196     |
| 295 | J&R Music World              | Systems, Hardware, Peripherals          | 334-337 |
| 340 | Minolta                      | Printers                                | 151     |
| 118 | Optique                      | Optique V95 19" Monitor                 | 218     |



## Advertisers' Index PRODUCTS

### Reader Service

| No. | Company             | Product                         | Page    |
|-----|---------------------|---------------------------------|---------|
| 298 | Optquest            | Opti-UPS                        | 331     |
| 047 | PC Connection       | PCs, Peripherals, Software      | 268-269 |
| 330 | PC Mall             | Hardware, Software, Peripherals | 264-265 |
| 015 | Philips Electronics | CD Rewritable Drive             | 166     |
| *   | Tektronix Inc.      | Graphic Printing and Imaging    | 194     |
| 066 | TigerDirect         | Hardware, Software, Peripherals | 343     |
| 117 | ViewSonic           | ViewSonic Monitor               | 84      |
| *   | Xircom              | Ethernet                        | 25      |

#### POWER PROTECTION

|     |                           |                                  |         |
|-----|---------------------------|----------------------------------|---------|
| 342 | American Power Conversion | Smart-UPS                        | 201-203 |
| 341 | American Power Conversion | Back-UPS Office                  | 325-327 |
| 080 | PC Power and Cooling      | Power Protection/Cooling Devices | 88      |
| 020 | PK Electronics            | Blackout Buster                  | 213     |
| 022 | PK Electronics            | Blackout Buster                  | 215     |
| 298 | Optquest                  | Opti-UPS                         | 331     |

#### PRESENTATION SOFTWARE

|     |               |                  |         |
|-----|---------------|------------------|---------|
| 005 | Epson America | Epson Projectors | 204-205 |
|-----|---------------|------------------|---------|

#### PRINTERS

|     |                   |                              |       |
|-----|-------------------|------------------------------|-------|
| 004 | Epson America     | Epson Printer                | 12-13 |
| *   | Hewlett Packard   | OfficeJet Pro 1150C          | 141   |
| *   | Hewlett Packard   | Printer-Cash in Trade Up     | 86    |
| 340 | Minolta           | Printers                     | 151   |
| 153 | NEC Technologies  | Printers                     | 224   |
| 205 | Ricoh Corporation | Ricoh Aficio Color Copiers   | 92    |
| *   | Tektronix Inc.    | Graphic Printing and Imaging | 194   |
| 051 | USA Flex          | Printers                     | 282   |

#### REMOTE COMPUTING

|   |                  |          |         |
|---|------------------|----------|---------|
| * | US Robotics Inc. | X2       | 109-112 |
| * | Xircom           | Ethernet | 25      |

#### SCANNERS

|     |       |         |    |
|-----|-------|---------|----|
| 268 | Nikon | Scanner | 14 |
|-----|-------|---------|----|

#### SERVERS

|     |                           |                      |         |
|-----|---------------------------|----------------------|---------|
| 092 | Acer America              | Mobile Client Server | 206-207 |
| 122 | AST Research              | Servers              | 22-23   |
| *   | Dell Computer Corporation | Notebooks/PCs        | C5-C8   |
| *   | Dell Computer Corporation | Dimension            | 82-83   |
| *   | Hewlett Packard           | NetServers           | 171     |
| *   | Oracle Corp.              | Oracle InterOffice   | 11      |
| 309 | S.A.G./Storage Solutions  | Servers and Storage  | 78-79   |
| 008 | Unisys Corporation        | Unisys Servers       | 106-107 |
| 006 | Unisys Corporation        | Unisys Servers       | 119     |

#### SOFTWARE

|     |                       |                                 |         |
|-----|-----------------------|---------------------------------|---------|
| 297 | ASP Computer Products | EZ MAIL                         | 249     |
| 297 | Cables to Go          | EZ MAIL                         | 249     |
| 294 | Cyber Media           | First Aid                       | 240     |
| *   | IBM Corporation       | VoiceType ViaVoice              | 20      |
| 003 | Micro Warehouse       | Hardware, Software, Systems     | 260-261 |
| *   | Microsoft             | Microsoft Office 97             | C2-C4   |
| *   | Microsoft             | Microsoft Office 97             | 1       |
| 047 | PC Connection         | PCs, Peripherals, Software      | 268-269 |
| 330 | PC Mall               | Hardware, Software, Peripherals | 264-265 |
| *   | SPSS, Inc.            | SPSS 7.5 for Windows            | 257     |
| 066 | TigerDirect           | Hardware, Software, Peripherals | 343     |
| *   | Visio                 | Visio                           | 80      |

#### STATISTICAL SOFTWARE

|     |            |                      |     |
|-----|------------|----------------------|-----|
| *   | SPSS, Inc. | SPSS 7.5 for Windows | 257 |
| 057 | Statsoft   | Statistical Software | 43  |

#### UTILITIES

|     |             |           |     |
|-----|-------------|-----------|-----|
| 294 | Cyber Media | First Aid | 240 |
|-----|-------------|-----------|-----|

#### VIDEO GRAPHICS/BOARDS

|     |                      |              |     |
|-----|----------------------|--------------|-----|
| 381 | Matrox Graphics Inc. | Millennium I | 127 |
|-----|----------------------|--------------|-----|

#### VOICE RECOGNITION SOFTWARE

|   |                 |                    |    |
|---|-----------------|--------------------|----|
| * | IBM Corporation | VoiceType ViaVoice | 20 |
|---|-----------------|--------------------|----|

#### WINDOWS SOFTWARE

|     |            |                      |       |
|-----|------------|----------------------|-------|
| *   | Micrograph | Flowchart 7          | 69    |
| *   | Microsoft  | Microsoft Office 97  | C2-C4 |
| *   | Microsoft  | Microsoft Office 97  | 1     |
| *   | SPSS, Inc. | SPSS 7.5 for Windows | 257   |
| 057 | Statsoft   | Statistical Software | 43    |
| *   | Visio      | Visio                | 80    |

#### WORK GROUP SOFTWARE

|   |                           |             |       |
|---|---------------------------|-------------|-------|
| * | Dell Computer Corporation | Workstation | 54-55 |
| * | Novell, Inc.              | NDS         | 26-27 |

#### WORKSTATION SOFTWARE

|   |                           |             |       |
|---|---------------------------|-------------|-------|
| * | Dell Computer Corporation | Workstation | 54-55 |
|---|---------------------------|-------------|-------|

#### WORKSTATIONS

|     |                           |                        |         |
|-----|---------------------------|------------------------|---------|
| *   | Dell Computer Corporation | Workstation            | 54-55   |
| *   | Hewlett Packard           | Workstation            | 178-179 |
| *   | Leap Frog Lab             | PCs/Notebooks/Upgrades | 270-271 |
| 335 | Sun Microsystems          | Workstation            | 5       |

For Additional Categories see MARKETPLACE PRODUCT INDEX PAGE 287.

# Coming Up

What's in the Next Issue of *PC Magazine*

## Video at Your Desktop

Digital video is bursting into the mainstream. We assess the complete package—both video-editing software and video-capture boards, including some with software.

## Streaming Video

The technology and products are coming together, delivering better quality and reasonable throughput. We review nine technologies for streaming video over your corporate LAN.

## Videoconferencing

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# The World's Most Advanced Notebook; 233MMX or 6x86!

The days of overpriced notebook PCs are over! Tiger presents a new lineup of ultra-powerful notebooks that deliver the absolute latest technology at direct-from-the-manufacturer prices. Four advanced stock systems: Low-voltage 6x86L PR166+, Pentium 166MMX, Pentium 200MMX, and the world's fastest notebook—a speed-burning Pentium 233MMX. Plus we can custom-configure any system to your specifications. Take a look—compare and you'll love our new Tiger notebooks—and they're covered by a rock-solid guarantee!

## PROCESSING

**Memory:** • 16, 32 or 48 MB EDO; expandable to 80MB; (16MB onboard plus one SO-DIMM Socket)  
**BIOS:** • 256KB FLASH Phoenix BIOS  
 • CD-ROM Boot, Plug & Play; APM 1.2  
**Cache:** • 256KB Pipeline Burst L2 cache

## VIDEO

**Display:** • 12.1" Color LCD Screen  
 • 800x600 in 256K colors (Dual Scan)  
 • 800x600 in 64K colors (Active Matrix)  
**Ext. CRT:** • 640x480 in 16 million colors  
 • 800 x 600 in 64K colors  
 • 1024x768 in 256 colors  
**VGA:** • PCI 128-bit graphics accelerator  
 • 12MB RAMBUS Video Memory  
 • ZV support for PCMCIA MPEG cards  
**Ports:** • 15-pin VGA port, Composite Video (TV)

## AUDIO

**Features:** • 16-bit, Sound Blaster compatible  
 • Built-in microphone and stereo speakers  
**Ports:** • Stereo Line-in; Line-out; earphone; mic

## IO

**PCMCIA:** • 2 Type II or 1 Type III; Plug & Play  
**Ports:** • (1) 9-pin serial, (1) 15-pin game, (1) 15-pin CRT, (1) 25-pin parallel, (1) Ext. PS/2 KB/mouse port, supports Y connector; (1) FIR infrared port, (1) TV Out, (1) 80-pin expansion port  
**Disk:** • Internal 3.5" floppy drive; 720K/1.44MB  
**Drives:** • Upgradeable hard disk drive; EIDE interface; 1.3, 1.6, 2.0 or 3.0 GB HD  
**CD-ROM:** • Built-in 5.25" format; 10-speed  
**Keyboard:** • 87/88-key; inverted-T cursor keys  
 • Supports Extra Windows 95 Hot Keys

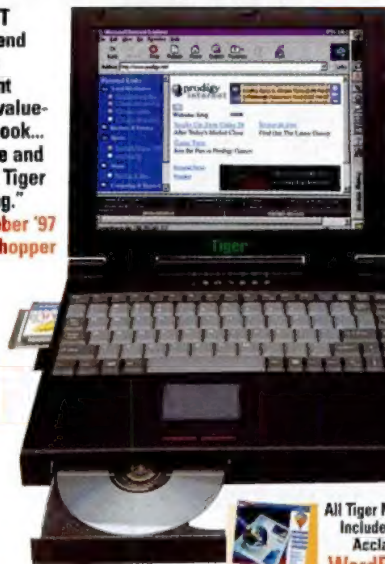
"The Tiger GT offers high-end components and a brilliant display in a value-priced notebook... for pure price and features, the Tiger GT is the King."

—October '97 Computer Shopper

**1 YEAR WARRANTY**



Designed for  
Microsoft  
Windows 95



**AMAZING!**  
**\$1699<sup>99</sup>**  
 6x86L PR166+, 16MB EDO RAM  
 1.3GB Hard Drive  
 10X CD-ROM

- 12.1" Active Matrix or High-Contrast Dual Scan Display
- Windows 95 Pre-loaded
- Corel WordPerfect Suite 8 Pre-loaded
- Turn-out for big-screen presentations
- 16-bit SoundBlaster compatible audio
- PCMCIA slot—Type II or Type III
- Built-in digital stereo speakers
- 128-bit PCI graphics With 12MB RamBUS RAM
- GlidePad pointing device
- ZV card support for MPEG
- 3.5" 1.44MB Floppy drive
- Duracell-compatible NiMH battery



Port Replicator Available... (Requires AC Adapter)

| Item#     | Processor            | EDO RAM/Max | H D    | CD-ROM | Screen   | Price      |
|-----------|----------------------|-------------|--------|--------|----------|------------|
| A113-5010 | Cyrix 6x86L PR166+   | 16MB/80MB   | 1.3 GB | 10X    | 12.1" DS | \$1,699.99 |
| A113-5030 | Intel Pentium 166MMX | 16MB/80MB   | 1.6 GB | 10X    | 12.1" AM | \$2,299.99 |
| A113-5040 | Intel Pentium 200MMX | 32MB/80MB   | 2.0 GB | 10X    | 12.1" AM | \$2,729.99 |
| A113-5050 | Intel Pentium 233MMX | 48MB/80MB   | 3.0 GB | 10X    | 12.1" AM | \$3,499.99 |

## New! 233 Powerhouse \$999<sup>99</sup>

**BUILD IT AND SAVE!**

Your Choice Of Processor:  
**Pentium MMX**  
**AMD-K6 MMX**  
**Cyrix 6x86MX**  
**233**

Imagine—assemble a brand new multimedia powerhouse and save up to \$300! Choose just the right processor for your kind of work from the best in the industry... a Pentium MMX 233MHz... or the AMD-K6 MMX 233MHz... or the IBM/Cyrix 6x86MX PR233. These are complete kits, easily assembled for a full-featured multimedia system. Is it easy? YES! In fact, you need only a screwdriver and about an hour—it's easier to assemble than that barbeque on your patio! Our state-of-the-art motherboard, high-speed memory and floppy drive are all pre-installed and 100% tested. Plus, includes a high-speed 20X CD-ROM drive, 33.6K faxmodem with voice (upgradable to 56K), 16-bit SoundBlaster Pro-compatible sound card with 3D Surround Sound, huge EIDE hard disk, S3 VIRGE 3D video with a full 4MB memory, premium Windows 95 keyboard, PS/2 mouse, digitally tuned stereo speakers, cables and more.

It's easy to assemble your new multimedia computer. We'll send you our step-by-step booklet to show you how it's done. After following the simple and easy-to-understand steps, you'll know how easy it is to add a second hard disk, add more memory, or even upgrade to a faster processor in the future. These are the same dependable, high-performance components we use in our own Tiger systems. Great value!

## Complete Kit Includes Everything! 100% Compatible!

State-of-the-art Motherboard accepts both SIMMs and new, faster DIMMs!



**S3 VIRGE 3D Video With 4MB Memory!**

**FASTEST 16MB DIMM INSTALLED**

The Smartest Buy In The Business!

## The Press Says Tiger Builds Great Computers...

"The Tiger K6 233 was this roundup's leading performer..."  
 "...its Business Winstone score led the pack."  
 "...its MMX numbers were unmatched."

PC Magazine Review of AMD-K6 Systems—June 24, 1997

## YOU GET ALL THIS:

- Cyrix 6x86MX PR233 or AMD-K6 MMX 233MHz or Pentium MMX 233MHz or IBM/Cyrix 6x86 PR200+
- PCI Motherboard
- 9-Bay Case
- 16 MB EDO DIMM RAM
- 3.0 or 4.3 GB EIDE Hard Disk
- 20X CD-ROM
- 33.6 KB Voice/Faxmodem
- 16-Bit 3D Surround Sound
- Amplified Stereo Speakers
- S3 VIRGE 3D Video With 4MB
- Premium Win95 Keyboard
- PS/2 Two-Button Mouse
- 3.5" 1.44MB Floppy Drive
- 512KB Pipelined Burst Cache
- 4 PCI and 4 ISA Slots
- ECP/EPP Parallel Port
- Two 16550 Serial Ports
- Two Universal Serial Bus Ports
- Onboard Jack for Infrared Port
- Third Cooling Fan in Case
- 200-Watt Power Supply
- Motherboard, CPU, RAM and Floppy Pre-installed and Tested

**BUILD IT YOURSELF AND SAVE!**

## Tiger Assemble-It-Yourself Multimedia Kits

| Item #    | Processor          | CD-ROM | Hard Disk | Price      |
|-----------|--------------------|--------|-----------|------------|
| A113-8801 | Cyrix 6x86 PR200+  | 20X    | 3.0GB     | \$799.99   |
| A113-8806 | Cyrix 6x86MX PR233 | 20X    | 3.0GB     | \$999.99   |
| A113-8705 | AMD-K6 MMX 233MHz  | 20X    | 4.3GB     | \$1,129.99 |
| A113-8605 | Pentium MMX 233MHz | 20X    | 4.3GB     | \$1,229.99 |

Sorry, but as prices are always changing on CPUs, we do not offer price protection in the event prices rise or fall. Ask for details and warranty information. Case design may vary due to updates.

**3GB HARD DRIVE**

• CAPACITY—3.0 GB • INTERFACE—EIDE Mode 4  
 • SEEK TIME—14 msec • TRANSFER RATE—16.6 MB/S  
 • SPINDLE SPEED—4500 RPM • BUFFER—128KB  
 • BAY SIZE—3.5" • WARRANTY—3 years

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**WESTERN DIGITAL KITS**

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|----------|--------|--------|
| W10-1136 | 3.1 GB | 259.99 |
| W10-1138 | 4.0 GB | 299.99 |
| W10-1140 | 5.1 GB | 369.99 |

**MAXTOR KITS**

|           |        |         |
|-----------|--------|---------|
| M122-2000 | 2.1 GB | 209.99* |
| M122-2004 | 3.5 GB | 289.99* |
| M122-2008 | 7.0 GB | 469.99* |

\*Price after \$30 mail-in rebate. Prices subject to change.

**MEMORY SALE! PNY**

**SIMM: EDO OR FAST PAGE SAME PRICE**

|                     |                          |                     |                           |
|---------------------|--------------------------|---------------------|---------------------------|
| <b>16 MB</b>        | <b>\$79<sup>99</sup></b> | <b>32 MB</b>        | <b>\$159<sup>99</sup></b> |
| #P56-1007 FAST PAGE | #P56-1023 EDO            | #P56-1009 FAST PAGE | #P56-1025 EDO             |

**DIMM: SDRAM OR EDO SAME PRICE**

|                   |                          |                   |                           |
|-------------------|--------------------------|-------------------|---------------------------|
| <b>16 MB</b>      | <b>\$99<sup>99</sup></b> | <b>32 MB</b>      | <b>\$199<sup>99</sup></b> |
| #P56-1209 - 16 MB |                          | #P56-1210 - 32 MB |                           |

EDO DIMMs—3.3v Burst-EDO Non Buffered 168-Pin. SDRAM DIMMs—3.3v 10ns (Up To 100 MHz) Non Buffered 168-Pin. Memory prices subject to change.

**TOSHIBA 220 CDS \$1969<sup>99</sup>**

• Pentium 133 MHz  
 • RAM/Max 16MB/44MB  
 • HD/CD ROM 134/10X  
 • Color Display 12.1" Dual Scan

**729-1528 220CDS \$1969.99**

**COMPAQ Armada 1500 \$1849<sup>99</sup>**

• Pentium 120MHz  
 • RAM/Max 16MB/80MB  
 • HD/CD ROM 1.08/10X  
 • Color Display 11.3" Dual Scan • Modem 33.6

**C150-1513 Armada 1510DM \$1849.99**

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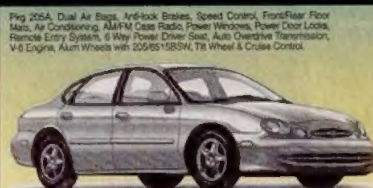
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(Java Report ad.)

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## Paging Roddy McDowell

Actual comments from the guest book  
of the *Planet of the Apes* Web site  
([spleenworld.com/apes/](http://spleenworld.com/apes/)):



"I'm gonna be a  
monkey. Monkey,  
monkey, monkey."

"I dink it thuckth!

As a monkey I am  
offended, nay, **INSULTED** by the  
portrayal of my hairy brethren as  
oppressors of mankind."

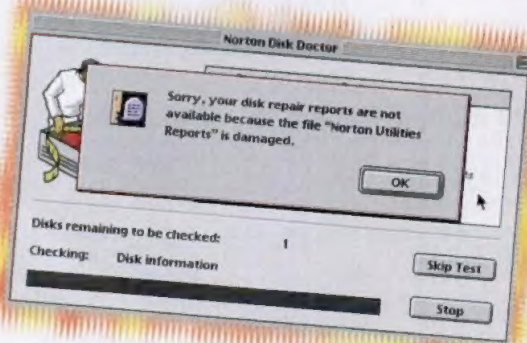
"I can watch those movies over and  
over again."

"Chimpanzees good! Gorillas bad!"

"All hail Chuck Heston! I can call him  
Chuck 'cuz he's a personal friend of mine."

"It's a madhouse! a madhouse!!!"

So what happens  
when the doctor  
gets sick? (Norton  
Disk Doctor  
screen.)



## Classified Intelligence

"PC Support Technician: Must be able  
to repair PCs, be familiar with Windows  
95/NT. Will be responsible for help  
desk operations, installations, configu-  
rations, troubleshooting. Also miscel-  
laneous party planning."—THE LOS  
ANGELES TIMES

"Multimedia Specialist: Consults with  
faculty and staff regarding the use of  
technologies for conveying information;  
works with faculty in the design and  
development of faulty Web sites."—THE  
DAYTON DAILY NEWS

What's next?  
Compaq dish-  
washers? IBM  
boats? (The San  
Francisco  
Examiner.)



"THAT'S A LOVELY SCANNED IMAGE OF  
YOUR SISTER'S PORTRAIT. NOW TAKE  
IT OFF THE BODY OF THAT PIT VIPER  
BEFORE SHE COMES IN THE ROOM."

If your entry is used, we'll send you \$50 and a *PC Magazine* T-shirt. Send your entries to Abort, Retry, Fail?, *PC Magazine*, One Park Ave., New York, NY 10016-5802. Winners this issue: Jounnard Endriga, Jeffrey Kikuchi, Karen O'Keefe, Aaron Smith, and Dawn Stowers.



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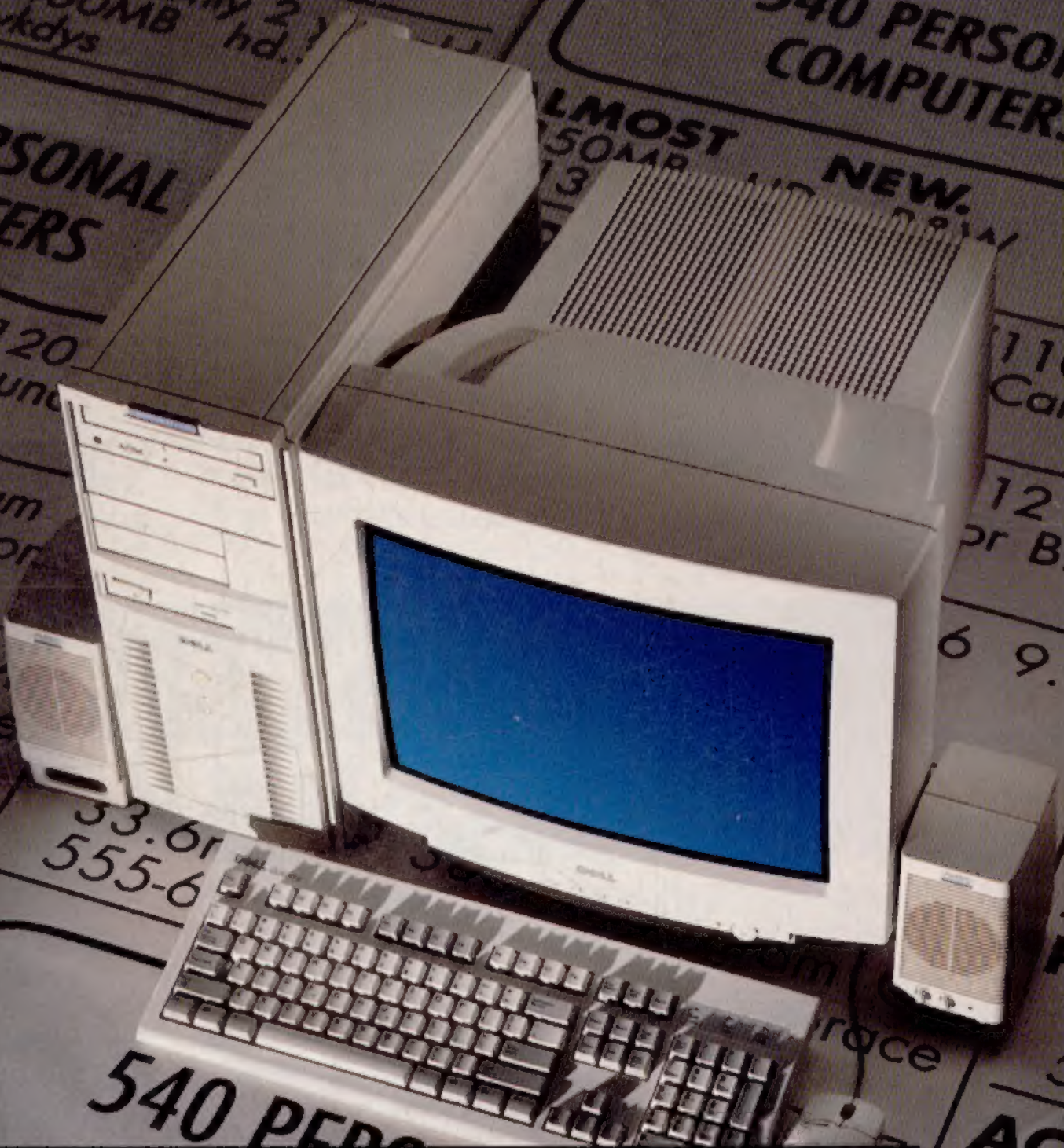
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